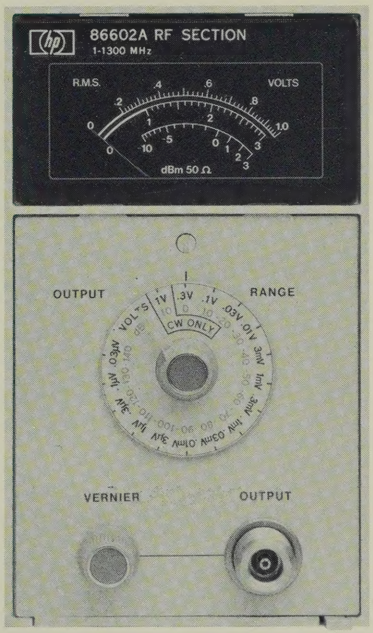
HP 86602A

OPERATING AND SERVICE MANUAL

RF SECTION
1-1300 MHz
86602A



HEWLETT PACKARD

HP 86602A

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facilities, or to the calibration facilities of other International Standards Organization members.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery. Hewlett-Packard will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

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OPERATING AND SERVICE MANUAL

RF SECTION 1-1300 MHz
86602A

Including Option 001

SERIAL NUMBERS

This Manual applies directly to instruments with serial numbers prefixed 1335A.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 1216A, 1239A, 1240A, 1241A, 1243A, 1245A, 1248A, and 1305A.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

HEWLETT-PACKARD COMPANY
1501 PAGE MILL ROAD, PALO ALTO, CALIFORNIA, U.S.A.

MANUAL PART NO. 86602-90011
Manual Microfiche Part No. 86602-90012
Operating Information Supplement Part No. 86602-90013

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WARNINGS

SAFETY

Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to retain the instrument in safe condition. Be sure to read and follow the safety information in Sections II, III, V, and VIII.

BEFORE CONNECTING THIS SYSTEM TO LINE (MAINS) VOLTAGE, the safety and installation instructions found in Sections II and III of the mainframe manual should be followed.

HIGH VOLTAGE

To avoid contact with the line voltage, remove the line (main) power cable from the power outlet before removing or connecting the output cables to the Frequency Extension Module.

Adjustments and troubleshooting are often performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

The multi-pin plug connector which provides interconnection from mainframe to RF Section, will be exposed with the RF Section removed from the right-hand mainframe cavity. With the Line (Mains) Voltage off and power cord disconnected, power supply voltages may still remain which, if contacted, may result in personal injury.

CAUTIONS

PERFORMANCE TESTING

To avoid the possibility of damage to the instrument or test equipment, read completely through each test before starting it. Then make any preliminary control settings necessary before continuing with the procedure.

PLUG-IN REMOVAL

Before removing the RF Section plug-in from the mainframe, remove the line (Mains) voltage by disconnecting the power cable from the power outlet.

SEMI-RIGID COAX

Slight but repeated bending of the semi-rigid coaxial cable will damage them very quickly. Bend the cables as little as possible. If necessary, loosen the assembly to release the cable.

MODEL 86602A

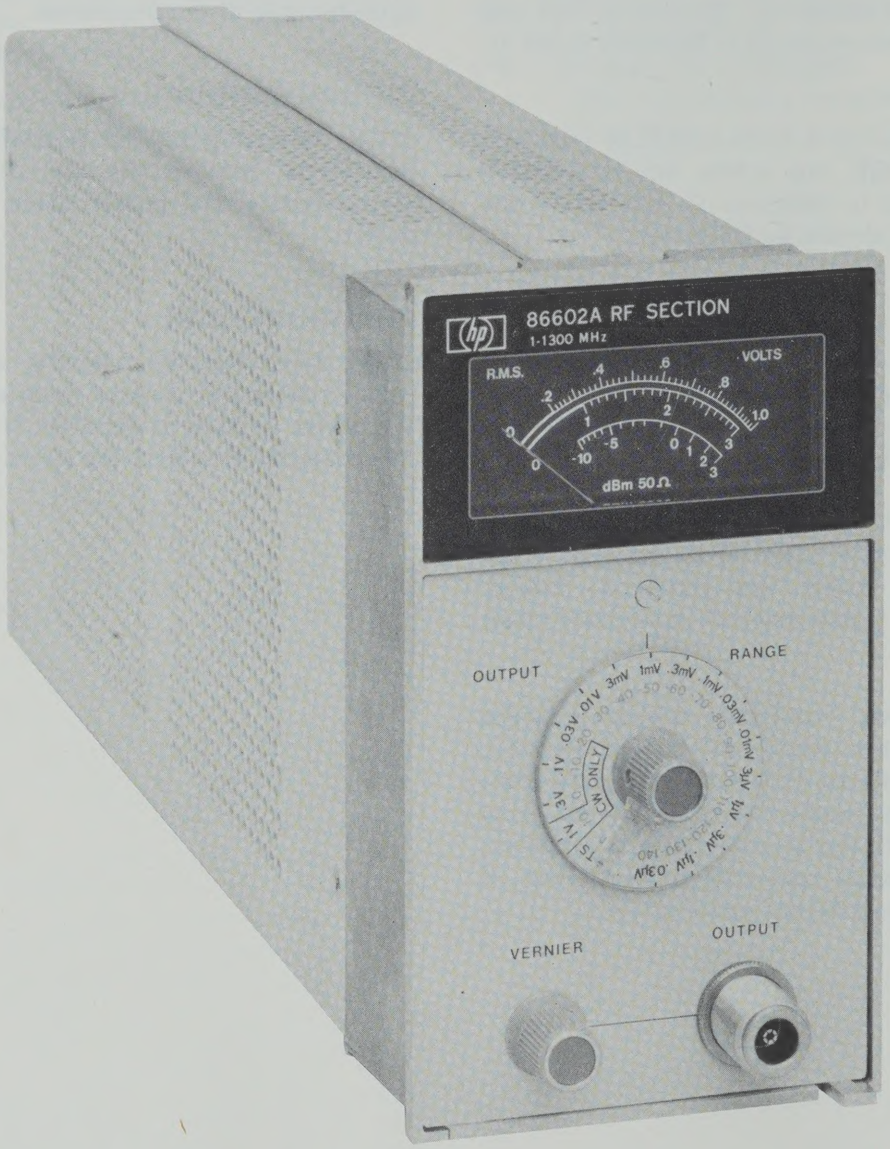


Figure 1-1. HP Model 86602A RF Section

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains all information required to install, operate, test, adjust and service the Hewlett-Packard Model 86602A RF Section plug-in, hereinafter referred to as the 86602A. For information concerning related equipment, such as the Hewlett-Packard Models 8660A and 8660B Synthesized Signal Generator mainframes or the Model 11661A Frequency Extension Module, refer to the appropriate manual or manuals.

1-3. This manual is divided into eight sections which provide information as follows:

a. SECTION I, GENERAL INFORMATION, contains the instrument description and specifications as well as the accessory and recommended test equipment list.

b. SECTION II, INSTALLATION, contains information relative to receiving inspection, preparation for use, mounting, packing, and shipping.

c. SECTION III, OPERATION, contains operating instructions for the instrument.

d. SECTION IV, PERFORMANCE TESTS, contains information required to verify that instrument performance is in accordance with published specifications.

e. SECTION V, ADJUSTMENTS, contains information required to properly adjust and align the instrument after repair.

f. SECTION VI, REPLACEABLE PARTS, contains information required to order all parts and assemblies or effect exchange of assemblies.

g. SECTION VII, MANUAL CHANGES, contains backdating information to make documentation in this manual applicable to all earlier versions of this instrument.

h. SECTION VIII, SERVICE, contains descriptions of the circuits, schematic diagrams, parts location diagrams, and troubleshooting procedures to aid the user in maintaining the instrument.

1-4. Figure 1-1 shows the HP Model 86602A RF Section.

1-5. Packaged with this manual is an Operating Information Supplement. This is simply a copy of the first three sections of this manual. This supplement should stay with the instrument for use by the operator. Additional copies of the Operating Information Supplement may be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

1-6. On the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 4 x 6-inch microfilm transparencies of the manual. Each microfiche contains up to 60 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

1-7. SPECIFICATIONS

1-8. Instrument specifications are listed in Table 1-1. These specifications are the performance standards, or limits against which the instrument may be tested.

1-9. INSTRUMENTS COVERED BY MANUAL

1-10. This instrument has a two-part serial number. The first four digits and the letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

1-11. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a yellow Manual Changes supplement that contains "change information" that documents the differences.

Table 1-1. Models 86602A/11661 Specifications (1 of 2)

SPECIFICATIONS

FREQUENCY CHARACTERISTICS

Range: 1.0 to 1299.999 999 MHz. Selectable in 1 Hz steps. Frequencies from 200 kHz to 1 MHz may also be selected with some degradation in specifications.

Accuracy and Stability: CW frequency accuracy and long term stability are determined by reference oscillator in 8660-series Mainframe (3×10^{-8}/24 hours) or by external reference if used.

Switching Time:

6 ms to be within 50 Hz of any new frequency selected.

100 ms to be within 5 Hz of any new frequency selected.

Largest Digit Changed	1 Hz 10 Hz	100 Hz	1 kHz, 10 kHz	100 kHz, 1 MHz	10 MHz	100 MHz, 1 GHz
Error at: 1 msec	<1 Hz	<100 Hz	< 500 Hz	<500 Hz	<500 Hz	Undefined
5 msec	<1 Hz	<1 Hz	<10 Hz	<50 Hz	<50 Hz	<50 Hz

Typical 86602A/11661
Frequency Switching Characteristics

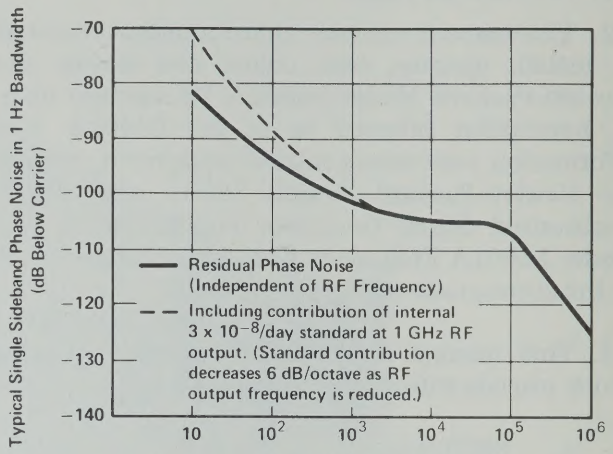
Harmonic Signals: All harmonically related signals are at least 30 dB below the desired output signal for output levels below +3 dBm. (−25 dB for output levels above +3 dBm.)

Spurious Signals:

Below 700 MHz, −80 dB.
Above 700 MHz, −80 dB within 45 MHz of carrier. −70 dB greater than 45 MHz from carrier (−50 dB on 1V range).
Power Line Related: −70 dB.

Signal-to-Phase Noise Ratio: Greater than 45 dB in a 30 kHz band centered on the signal excluding a 1 Hz band centered on the carrier.

Typical SSB Phase Noise Curve:



Typical 86602A Phase Noise

Residual FM: <1.5 Hz rms in a 2 kHz bandwidth centered on the carrier (CW, AM only).

Signal-to-AM Noise Ratio: Greater than 65 dB in a 30 kHz bandwidth centered on the carrier at output level of +10 dBm

OUTPUT CHARACTERISTICS

Level: Continuously adjustable from +10 to −146 dBm (0.7V to 0.01 μV rms) into 50 ohm resistive load; output attenuator calibrated in 10 dB steps from 1.0V (+13 dBm) full scale to 0.03 μV (−137 dBm) full scale; vernier provides continuous adjustment between attenuator ranges; output level indicated on output level meter calibrated in volts and dBm into 50 ohms.

Accuracy: (Local and remote modes)
±1.5 dB +10 dBm to −76 dBm.
±2.0 dB −77 dBm to −146 dBm.

Flatness: Output level variation with frequency is less than ±1.0 dB across entire frequency range. (Typically ±0.5 dB 100 MHz to 1300 MHz.)

Level Switching Time: Any level change may be accomplished in less than 50 ms. Any change to another level on the same attenuator range may be accomplished in 5 ms in REMOTE mode.

Impedance: 50Ω. SWR <2.0 on 1 volt and 0.3 volt ranges. SWR <1.3 on 0.1 volt range and below.

Table 1-1. Models 86602A/11661 Specifications (2 of 2)

MODULATION CHARACTERISTICS
(With 86632A and 86633A AM-FM Modulation Sections)

Amplitude Modulation:

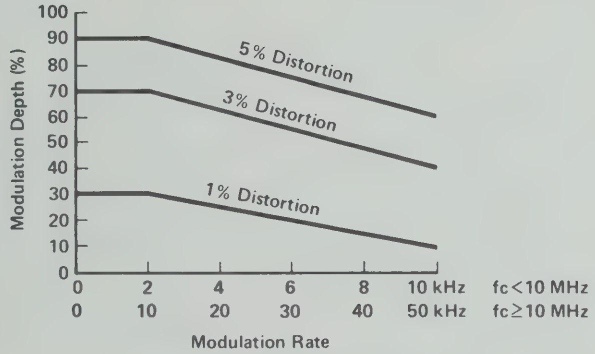
Depth: 0 — 90% on 0.3 volt range and below. (Modulation is possible on 1V range depending on setting of vernier.)

AM 3 dB Bandwidth:

Center Frequency	0 to 30% AM	70% AM	90% AM
Fc <10 MHz	10 kHz	6 kHz	5 kHz
Fc ⩾10 MHz	100 kHz	60 kHz	50 kHz

AM Distortion: (at 400 Hz and 1 kHz rates)[1]

Frequency Range	30%	70%	90%
1—1300 MHz	<1%	<3%	<5%



(RF meter set at 0dB or above)

Typical 86602A AM distortion curves

Indicated AM Accuracy: (400 Hz and 1 kHz rates using internal meter) ±5% of full scale.

Incidental PM: Less than 0.2 radians peak at 30% AM.

Incidental FM: 0.2 x f_{mod} at 30% AM.

Frequency Modulation: [2]

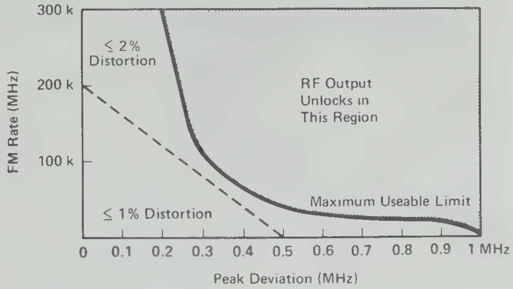
Rate: DC to 200 kHz with 86632A
DC to 100 kHz with 86633A

Max. Deviation: DC to 200 kHz with 86632A
DC to 100 kHz with 86633A

Indicated FM Accuracy: ±5% of full scale up to 20 kHz rates.

Incidental AM: With 75 kHz peak deviation at a 1 kHz rate, AM modulation sidebands are <−60 dB.

FM Distortion: (at rates up to 20 kHz) <1% for deviations up to 200 kHz.



Typical 86602A FM distortion curves

PULSE MODULATION
(With the 86631B Auxiliary Section)

Source: External.

ON/OFF Ratio: At least 40 dB (with modulation level control at max.)

Rise/Fall Time: 50 ns.

Input Level Required: 0 to −10V negative voltage turns RF on.

REMOTE PROGRAMMING
(Through the 8660-series mainframes)

Frequency: Programmable in 1 Hz steps over full output range.

Output Level: Programmable in 1 dB steps from +10 to −146 dBm.

Modulation: See specifications for modulation section installed.

GENERAL

Leakage: Meets radiated and conducted limits of MIL-I-6181D.

86602A:

Size: Plug-in to fit 8660-series mainframe.

Weight: Net, 9 lb (4,1 kg).

11661:

Size: Module installs internally in 8660-series mainframe.

Weight: Net, 4 lb (1, 8 kg)

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[1] This is for RF output meter set at 0 dB or above. At −6 dB setting, distortion is approximately doubled.

[2] In the FM mode (86632A only), carrier frequency stability is determined by a free-running modulation oscillator. The oscillator can be phase-locked momentarily to remove drift by depressing the FM-CF CAL button. Oscillator drift is typically less than 200 Hz/hour after 6-hour mainframe warmup and 30 minutes operation in FM mode.

1-12. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to this manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-13. For information concerning a serial number prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-14. DESCRIPTION

1-15. The HP Model 86602A RF Section is one of several RF Sections available for use in an 8660-series Synthesized Signal Generator System. The HP Model 86602A RF Section plug-in is used with a Synthesized Signal Generator mainframe that has a Frequency Extension Module installed. The 86602A provides precisely tuned RF output frequencies over the 1 MHz to 1.3 GHz range with a 1 Hz frequency resolution (100 Hz for option 004 mainframe). Frequencies from 200 kHz to 1 MHz can also be generated with some degradation in the amplitude leveling and related specifications of the instrument.

1-16. The output power can be set to any level between +10 and —146 dBm by means of the front panel VERNIER and calibrated OUTPUT RANGE controls. A front panel-mounted meter indicates the output power and voltage levels delivered by the RF Section to any external load having a characteristic impedance of 50 ohms. Output power levels are maintained within ±1 dB of selected values through internal leveling of the output signal over the full frequency range of the instrument.

1-17. AM, FM, or pulse modulation of the RF OUTPUT signal can be accomplished within the 86602A by using the appropriate HP plug-in (Auxiliary Section or AM-FM Modulation Section) in the system.

1-18. External programming, inherent with the 86602A and associated HP equipment, permits remote selection of the output signal frequency in 1 Hz steps (100 Hz for option 004 mainframe) and the output power level in 1 dB steps over the full operating range of the instrument. External programming is effected via the mainframe computer-compatible interface and digital control unit circuits.

1-19. OPTION 001

1-20. Option 001 has no RF output attenuator. Output ranges selectable with OUTPUT RANGE switch are 0 and +10 dBm only.

1-21. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-22. System Mainframe

1-23. The mainframe uses phase-locked loops to accurately generate clock, reference, and tuning signals required for operation of the Synthesized Signal Generator System. Front panel-mounted mainframe controls are used to digitally tune two phase-locked loops in the Frequency Extension Module which, in turn, produce two high-frequency output signals that are applied to the RF Section. The RF Section mixes the two signals and presents their frequency difference at the front panel OUTPUT jack. The output frequency is either the value selected by the mainframe front panel controls or externally programmed.

1-24. The mainframe power supply provides all dc operating voltages required by the 86602A, Frequency Extension Module, and AM-FM Modulation Section plug-ins. Remote programming of the plug-ins is accomplished via the mainframe interface and digital control unit circuits.

1-25. Frequency Extension Module

1-26. The Frequency Extension Module plug-in extends the output frequency range of the mainframe to meet the input requirements of the 86602A. The Frequency Extension Module plug-in contains two high-frequency phase-locked loops which receive digital tuning signals, variable synthesized signals, and fixed synthesized signals from the mainframe. The phase-locked loops use the mainframe signals, in conjunction with the output frequency from a 4.43 GHz oscillator that is common to both loops, to produce two high-frequency output signals that are supplied to the 86602A. One output signal is generated by a phase-locked loop using a Voltage Controlled Oscillator (VCO) that is tuneable in 1 Hz steps (100 Hz steps for option 004 mainframe) over the

Table 1-2. Test Equipment and Accessories List (1 of 2)

Item	Critical Specifications	Suggested Model	Use*
Digital Voltmeter	Accuracy: ±0.2% Range: .00 to 60 Volts	HP 34740A with HP 34702A	T
AC Voltmeter	1 Hz to 1 MHz 1 mVrms to 10 Vrms	HP 403A	P,A
Vector Voltmeter	10 to 100 MHz 0.1 to 1.0 Vrms	HP 8405A	P
Accessory Kit (Vector Voltmeter)	50Ω Load and Tee	HP 11570A	P
Oscilloscope	Vertical: Bandwidth 50 MHz with sensitivity of 5 mV/division minimum Horizontal: Sweep time 10 ns to 1 s Delayed sweep External triggering to 100 MHz	HP 180A with HP 1801A and HP 1821A plug-ins	P,T
10 ÷ 1 divider probes (two)	10:1 divider 10 Megohm 10 pF	HP 10004	
Spectrum Analyzer	Absolute Accuracy ±1.6 dB from 10 MHz to 1.3 GHz Measurement Accuracy ±2.6 dB from 10 MHz to 1.3 GHz	HP 8555A with HP 8552B and HP 140S	P,A,T
Test Oscillator	1 kHz to 20 kHz 0.2 to 2.0 Vrms into 50Ω	HP 651B	P,A
Synthesized Signal	±1 Hz from .01 MHz to 110 MHz ±2 dB from +10 to −90 dBm	HP 8660A with HP 86631B and HP 86602A plug-ins	P
Modulator Section	1 kHz FM with 1 MHz peak deviation	HP 86632A	P
Computing Counter	50 kHz to 50 MHz with a 1 ms gate time and external trigger; 1 Hz resolution	HP 5360A with HP 5365A plug-in	P
Wave Analyzer	20 Hz to 40 kHz	HP 302A	P
Crystal Detector	100 kHz to 100 MHz	HP 8471A	P
Power Supply	0 - 10 volts	HP 721	P
Marked Card Programmer	Capable of programming BCD or GPI bus data	HP 3260A Opt 001	P,A

*USE: P = Performance Tests; A = Adjustments; T = Troubleshooting

Table 1-2. Test Equipment and Accessories List (2 of 2)

Item	Critical Specifications	Suggested Model	Use*
Frequency Meter/ FM Discriminator	100 kHz to 10 MHz with 1 volt output sensitivity	HP 5210A	P
Variable Coaxial Attenuator	Calibrated at 30 MHz; refer to calibration curve	HP H38-355D (only)	P
Double Balanced Mixer	1 MHz to 110 MHz	HP 10514A	P
BNC Tee		UG 274 B/U	P,A
Variable Phase Generator	Distortion less than 3% Range: 1 kHz to 20 kHz Output level: 0.1 to 1.0 Vrms	HP 203A	P
15 kHz Lowpass Filters (two)	Special	(see Figure 1-3)	P
100 kHz Lowpass Filter	Special	(see Figure 1-4)	P
40 dB Amplifier	Special	(see Figure 1-5)	P
Service Kit	Interconnect cables, adaptors, coaxial cables compatible to 8660-series plugs and jacks	HP 11672A (see Operating Note for parts list)	A, T
Microwave Frequency Counter	Range: 0.2 - 1300 MHz Resolution: 1 Hz	HP 5340A	P
Power Meter	Range: 0 to +10 dBm from 10 MHz	HP 432A	P,A,T
Thermistor Mount	1 MHz - 1 GHz at SWR ≤ 1.3	HP H55-478A	P,A
Fixed Attenuator	3 dB	HP 8491A Opt. 003	P,A
Pulse Generator	Output —10 Vpk with ≥10 ns risetime	HP 8013A	P
Crystal Detector	Frequency response to 10 GHz	HP 420A	P
Low Pass Filter	Cutoff frequency: 2200 MHz	HP 360C	P
Termination, 50Ω Feedthru	50Ω	HP 11048C	P
Double Balanced Mixer	100 to 1300 MHz	Relcom MIA-11	P

*USE: P = Performance Tests; A = Adjustments; T = Troubleshooting

3.95 to 4.05 GHz range. The other output signal is generated by a phase-locked loop using a Yittrium-Iron-Garnet (YIG) oscillator that is tunable in 100 MHz steps over the 2.75 to 3.95 GHz range. The two outputs from the Frequency Extension Module plug-in are applied to the 86602A for mixing, amplification of the converted signal, and final output power level control.

1-27. Auxiliary Section

1-28. The Auxiliary Section plug-in provides a means of applying externally generated amplitude or pulse modulation drive signals to the 86602A for modulation of the generated output carrier.

1-29. Modulation Section Plug-ins

1-30. The Model 86630-series AM-FM Modulation Section plug-ins can accept externally generated signals or develop internal signals to be used for calibrated amplitude or frequency modulation of the output signal from the 86602A. The AM signals are supplied to the 86602A for modulation of the generated output carrier as previously described in the paragraph discussing the Auxiliary Section plug-in.

1-31. In the FM mode, the AM-FM Modulation Section plug-in supplies a 20 MHz frequency modulated signal to the reference input of a phase detector in the Frequency Extension Module phase-locked YIG loop. Thus, as the 20 MHz frequency modulated signal varies, the YIG loop output frequency varies accordingly. When the modulated YIG loop output is mixed in the 86602A with the VCO loop output, the resultant RF signal retains the FM characteristics provided by the AM-FM Modulation Section plug-in.

1-32. EQUIPMENT AVAILABLE

1-33. Three extender cables, HP Part Numbers 11672-60001, -60005, and -60006, are required to extend the 86602A plug-in for maintenance purposes. The extender cables are part of the HP 11672A Service Kit, but may be ordered separately.

1-34. Extender cards for use in servicing the 86602A and a type N to BNC adapter for use on the front panel RF OUTPUT connector are contained in the HP Rack Mount Kit, Part Number 08660-60070, that is supplied with the mainframe.

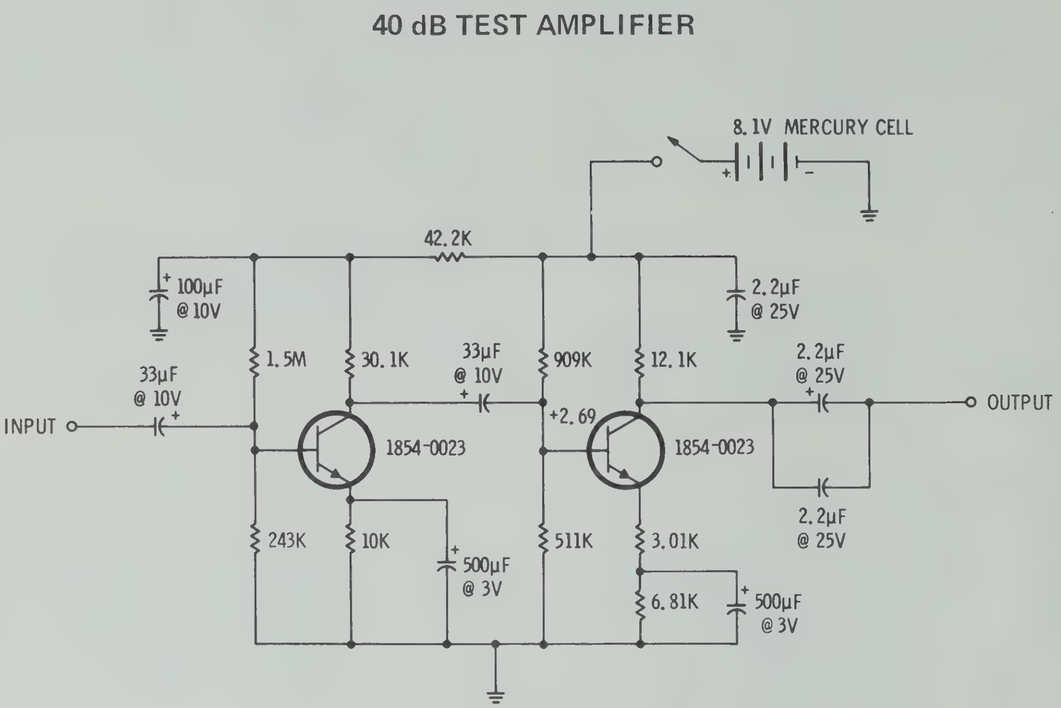
1-35. RECOMMENDED TEST EQUIPMENT

1-36. Table 1-2 lists the test equipment and accessories recommended for use in testing, adjusting, and servicing the 86602A. If any of the recommended test equipment is unavailable, instruments with equivalent specifications may be used.

1-37. SAFETY CONSIDERATIONS

1-38. This instrument has been designed in accordance with international safety standards and has been supplied in safe condition.

1-39. Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to retain the instrument in safe condition. Be sure to read and follow the safety information in Sections II, III, V, and VIII.



Amplifier Specifications

Gain	44 dB at 25°C
Bandwidth	100 kHz (3 dB down)
Noise Bandwidth	157 kHz
Input Impedance	75 K Ohms
Output Impedance	12 K Ohms
Current Drain	260 Microamperes
Output (Maximum)	1 Volt
Dynamic Range	66 dB

Figure 1-2. 40 dB Test Amplifier

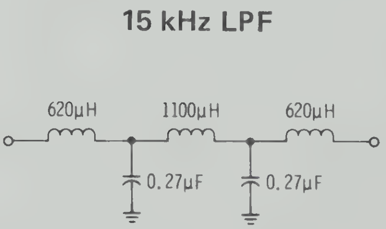


Figure 1-3. 15 kHz Low Pass Filter

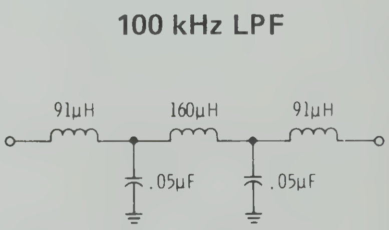


Figure 1-4. 100 kHz Low Pass Filter

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section provides information relative to initial inspection, preparation for use, and storage and shipment of the Model 86602A RF Section plug-in. INITIAL INSPECTION provides instructions to be followed when an instrument is received in a damaged condition. PREPARATION FOR USE gives all necessary interconnection and installation instruction. STORAGE AND SHIPMENT provides instructions and environmental limitations pertaining to instrument storage; also provided are packing and packaging instructions which should be followed in preparing the instrument for shipment.

2-3. INITIAL INSPECTION

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1, and procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. All power required for operation of the 86602A is furnished by the mainframe. The 86602A requires approximately 70 volt-amperes.

2-8. Interconnections

2-9. Prior to installing the 86602A plug-in into the mainframe, verify that the Frequency Extension Module plug-in and interconnecting cable assemblies have been installed in accordance with the instructions contained in the Frequency Extension Module manual.

2-10. Operating Environment

2-11. The Model 86602A RF Section is designed to operate within the following environmental conditions:

Temperature	0° to +55°C
Humidity .	less than 95%, relative
Altitude . . .	less than 15,000 feet

2-12. Installation Instructions

WARNING

The multi-pin plug connector which provides interconnection from mainframe to RF Section, will be exposed with the RF Section removed from the right-hand mainframe cavity. With the Line (Mains) Voltage off and power cord disconnected, power supply voltages may still remain which, if contacted, may result in personal injury.

2-13. Insert the 86602A plug-in approximately half-way into the right cavity of the mainframe. Rotate the latch (lower right corner of 86602A front panel) to the left until it protrudes perpendicular to the front panel. Refer to Figure 2-1, which shows the 86602A plug-in partially inserted into the mainframe and the latch rotated to a position that is perpendicular to the plug-in front panel. Push the 86602A plug-in all the way into the mainframe drawer and then rotate the latch to the right until it snaps into position.

2-14. STORAGE AND SHIPMENT

2-15. Environment

2-16. The storage and shipping environment of the Model 86602A should not exceed the following limits:

Temperature	40° to +75°C
Humidity	less than 95%, relative
Altitude	less than 25,000 feet

2-17. Packaging

2-18. Original Type Packaging. Containers and materials identical to those used in factory packaging are available thorugh Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-19. Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

c. Use enough shock-absorbing material (3- to 4-inch layer) around all the sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

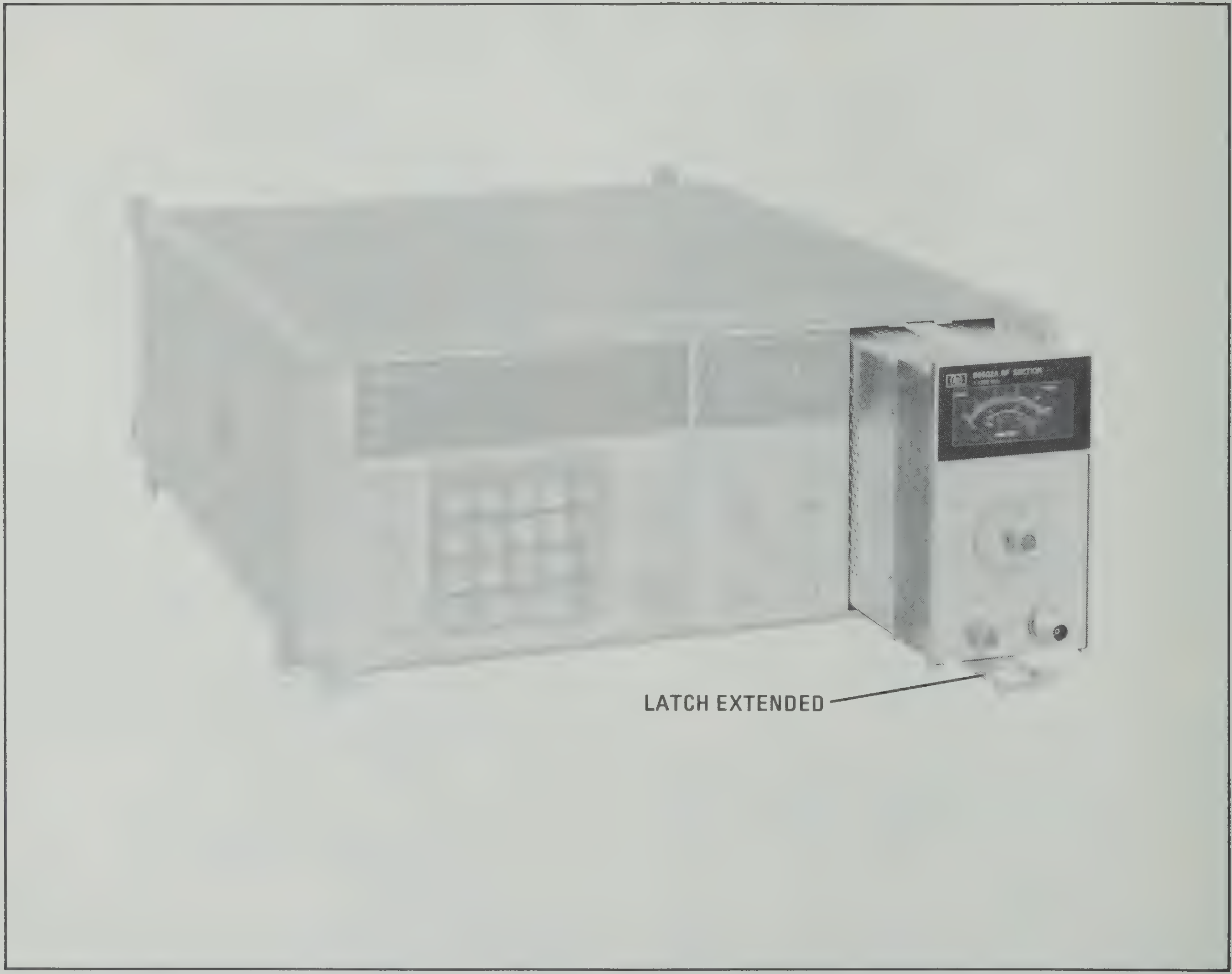


Figure 2-1. RF Section Partially Inserted into Mainframe

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section contains information which will enable the operator to learn to operate and quickly check the proper operation of the RF Section plug-in as part of the Synthesized Signal Generator System.

3-3. PANEL FEATURES

3-4. The Front and Rear Panel Controls, Connectors, and Indicators of the RF Section are described by Figure 3-1.

3-5. OPERATOR'S CHECKS

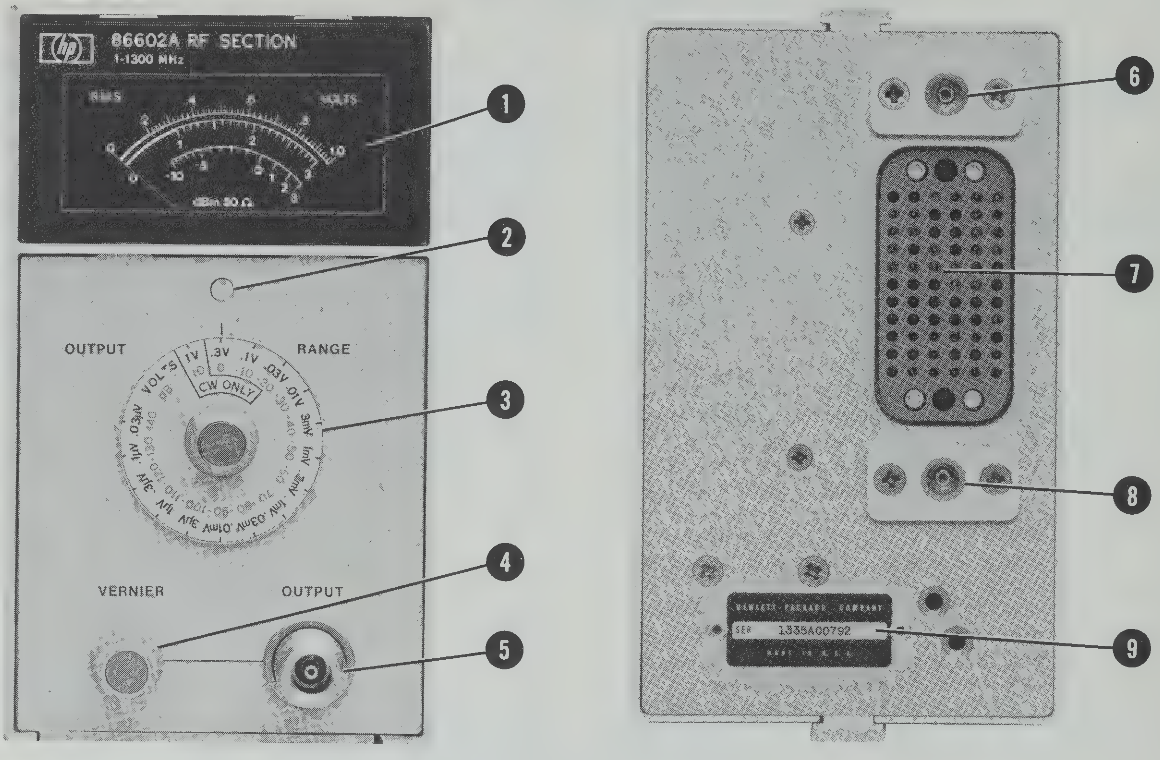
3-6. The RF Section, as part of the Synthesized Signal Generator System, accepts inputs from the rest of the system but controls only the RF Output level. Even though the controlled circuits for these functions are within the RF Section, the actual checks are found in the manual of the instrument which controls that function.

3-7. The Operator's Checks in this manual are intended to verify proper operation of the circuits which control and are controlled by the RF Output level controls. This includes the meter, VERNIER control, OUTPUT RANGE Switch, and the Output Range Attenuator when operating in the Local mode. When the system is being remotely controlled, the 1 dB and 10 dB remote step attenuators switches are checked in place of the VERNIER Control and OUTPUT RANGE Switch. Refer to Figure 3-2.

3-8. OPERATING INSTRUCTIONS

3-9. In this system, the mainframe and plug-ins contain the controls for frequency, modulation, and RF level selection. The mainframe controls frequency, the Modulation Section plug-in controls modulation type and level, and the RF Section plug-in controls RF output level. The Operating Instructions for the RF Section plug-in are included in Table 3-1.

FRONT AND REAR PANEL FEATURES



① **Meter.** Indicates the RF Output level in Vrms and dBm (50Ω) referenced to the scale indicated by the OUTPUT RANGE Switch.

② **Mechanical Meter Zero Control.** Sets the Panel Meter indicator to zero when the Mainframe LINE Switch is set to STBY.

③ **OUTPUT RANGE Switch.** Sets the RF Output level range from +10 to −140 dBm in 10 dB steps (1.0 Vrms to 0.03 μVrms full scale).

④ **VERNIER Control.** RF Output continuously variable within the useable 10 dB range (+3 to −6 dB) as indicated by the meter.

⑤ **OUTPUT Jack.** Type-N female coaxial connector. RF Output level +10 to −146 dBm (1.0 Vrms to 0.01 μVrms) across a 50Ω load.

⑥ **Coaxial Plug.** Connects the 2.75/3.95 GHz RF Input signal to the RF Section from the Frequency Extension Module.

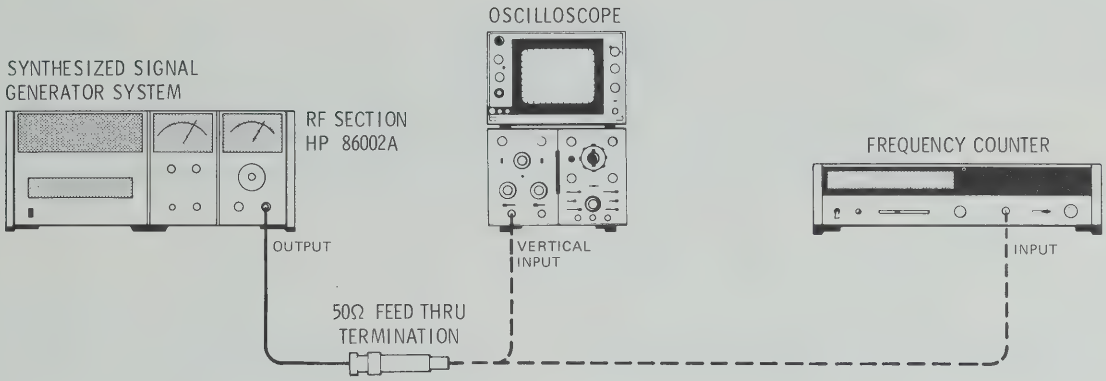
⑦ **Interconnect Plug.** Provides interconnection of power supply voltages, RF and control signals between the RF Section plug-in and the Mainframe, Frequency Extension Module, and Modulation Section plug-in.

⑧ **Coaxial Plug.** Connects the 3.95/4.05 GHz LO Input signal to the RF Section plug-in from the Frequency Extension Module.

⑨ **Serial Number Plate.** Metal plate with stamped serial number. Four-digit and letter for prefix. Suffix is unique to this instrument.

Figure 3-1. Front and Rear Panel Controls, Connectors, and Indicators

OPERATOR'S CHECKS



WARNING

BEFORE CONNECTING THIS SYSTEM TO LINE (MAINS) VOLTAGE, the safety and installation instructions found in Sections II and III of the mainframe manual should be followed.

NOTE

Refer to Section II for RF Section Installation instructions.

1. Set the system controls as follows:

   Mainframe
     LINE Switch . . . . ON
     REFERENCE SELECTOR (Using internal time base) INT
     CENTER FREQUENCY . . . . 10 MHz
   Modulation Section Plug-in
     MODE Switch . . . . OFF
   RF Section Plug-in
     OUTPUT RANGE Switch . . . . −10 dBm (0.1V)
     VERNIER Control (for a meter reading of +3 dB) −7 dBm (0.1 Vrms)

2. Connect the system's OUTPUT to the oscilloscope's vertical input (>10 MHz bandwidth) and then to the frequency counter's input through a 50Ω feed-thru termination. Verify that the amplitude of the 10 MHz signal is ≈280 mVp-p.

3. Set the OUTPUT RANGE Switch to the +10 dBm (1.0V) range. Verify that the output level is ≈2 Vp-p.

4. To check the remote control capabilities of the RF Section, connect a control unit to the mainframe. Repeat steps 2 through 4 while the system is remotely programmed from an external source. Application Note 164-1 "Programming the 8660A/B Synthesized Signal Generator" provides the information needed for remote operation of this system. Section III of the mainframe manual contains the same information in abridged form.

Figure 3-2. Operator's Checks

Table 3-1. Operating Instructions

OPERATING INSTRUCTIONS

TURN ON

WARNING

BEFORE CONNECTING THIS SYSTEM TO THE LINE (MAINS) VOLTAGE, the safety and installation instructions found in Sections II and III of the mainframe manual should be followed.

NOTE

Refer to Section II for RF Section Installation Instructions.

1. Set the mainframe's LINE Switch to ON and the rear panel REFERENCE SELECTOR Switch to INT.

FREQUENCY SELECTION

2. Refer to Section III of the mainframe operation and service manual for information on system frequency selection.

MODULATION SELECTION

3. Refer to Section III of the Modulation Section plug-in operating and service manual for information relating to selection of modulation type and level.

RF OUTPUT LEVEL

4. Set the OUTPUT RANGE Switch and the VERNIER Control for the desired output level. To ensure the accuracy of the output level and/or modulated output, the meter reading of output level should always be set between —6 and +3 dBm.

REMOTE OPERATION

5. Application Note 164-1 "Programming the 8660A/B Synthesized Signal Generator" provides the information needed for remote operation of this system. In abridged form, Section III of the mainframe manual contains the same information.

GENERAL

6. Connect the RF Output to the Device Under Test. The front panel meter reading of RF Output level will be correct only if the input impedance of the Device Under Test is 50Ω.

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler operational test is included in Section III under Operator's Checks.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the performance tests is listed in the Recommended Test Equipment table in Section I. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4-5. TEST RECORD

4-6. Results of the performance tests may be tabulated on the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

4-7. PERFORMANCE TESTS

4-8. For each test, the specifications are written exactly as they appear in the Specification table in Section I. Next, a description of the test and any special instructions or problem areas are included. Most tests that require test equipment have a setup drawing; each has a list of required equipment. The initial steps of each procedure give control settings required for that particular test.

CAUTION

To avoid the possibility of damage to the instrument or test equipment, read completely through each test before starting it. Then make any preliminary control settings necessary before continuing with the procedure.

PERFORMANCE TESTS

4-9. FREQUENCY RANGE

SPECIFICATION:

1.0 to 1299.999 999 MHz. Selectable in 1 Hz steps. Frequencies from 200 kHz to 1 MHz may also be selected with some degradation in specifications.

DESCRIPTION:

The Synthesized Signal Generator System RF OUTPUT is monitored by a frequency counter which supplies a common time base reference signal. The frequencies are checked at the extremes. Any specified frequency may be checked.

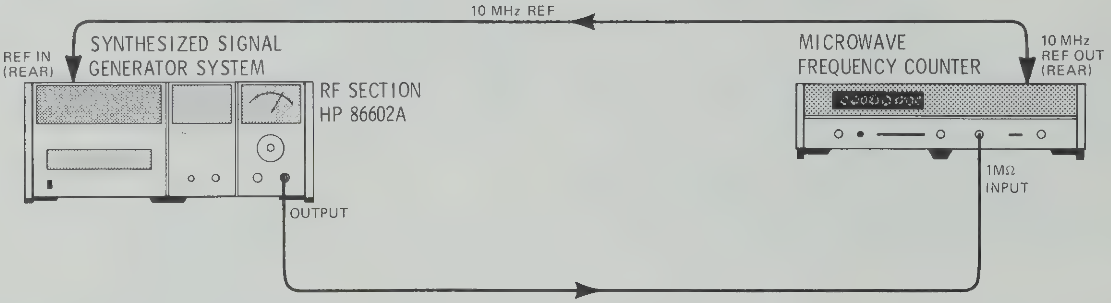


Figure 4-1. Frequency Range Test Setup

EQUIPMENT:

Microwave Frequency Counter . . . . HP 5340A

PROCEDURE:

NOTE

In the following procedure, allow for accuracy of counter used. Model recommended is specified at ±1 count.

1. Connect frequency counter 10 MHz output reference signal to mainframe EXT REF input and set mainframe rear panel REF switch to EXT.

2. Set mainframe center frequency to 1.000 000 MHz and check RF section output frequency with counter. Record the frequency.

0.999 999____________________1.000 001 MHz

3. Set mainframe center frequency to 1299.999 999 MHz (Option 004 mainframe set to 1299.9999 MHz) and check RF Section output frequency with counter. Record the frequency.

0.999 999____________________1.000 001 MHz

PERFORMANCE TESTS

4-10. FREQUENCY ACCURACY AND STABILITY

SPECIFICATION:

CW frequency accuracy and long term stability are determined by reference oscillator in 8660A/B Mainframe (3×10^{-8} /24 hours) or by external reference if used.

NOTE

If there is any reason to doubt the mainframe crystal oscillator accuracy or stability, refer to the performance test in Section IV of the mainframe manual.

4-11. FREQUENCY SWITCHING TIME

SPECIFICATION:

6 ms to be within 50 Hz of any new frequency selected. 100 ms to be within 5 Hz of any new frequency selected.

DESCRIPTION:

A change in the Synthesized Signal Generator System's frequency is remotely programmed; after a preset time interval the frequency is measured. A trigger pulse from the programming device is first coupled to the oscilloscope. The pulse is delayed a preset interval by the oscilloscope and then coupled to the computing counter at which time the frequency is measured.

NOTE

The frequencies were selected for worst-case conditions (longest switching time).

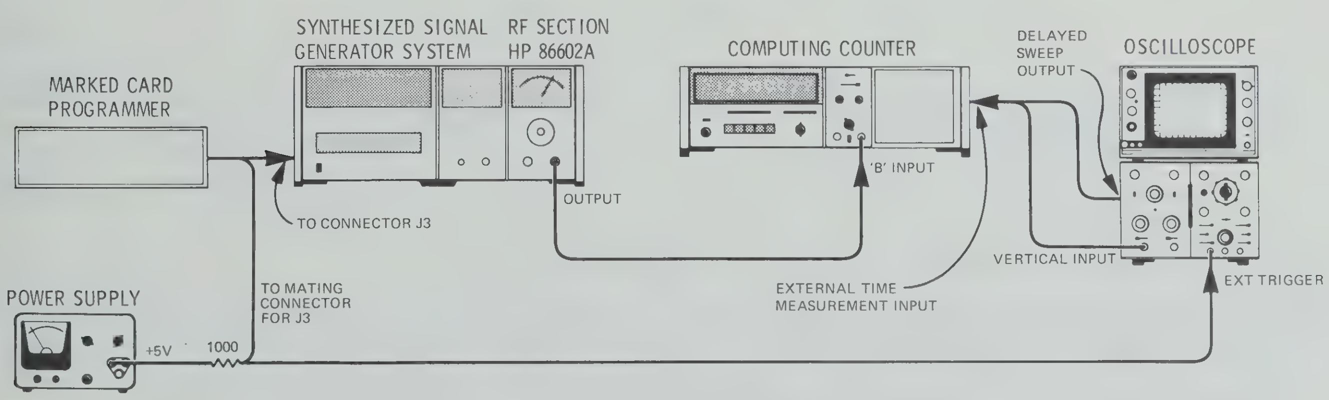


Figure 4-2. Frequency Switching Time Test Setup

EQUIPMENT:

DC Power Supply	HP 721A
Computing Counter	HP 5360A/5365A
Marked Card Programmer	HP 3260A/Opt 001
Oscilloscope	HP 180C/1801A/1821A

4-11. FREQUENCY SWITCHING TIME (Cont'd)

PROCEDURE:

1. Connect dc power supply +5 volt output through a 1000 Ohm resistor to pin 17 of mating connector for J3. Pin 17 (flag) of Marked Card Programmer output connector is also connected to oscilloscope ext trigger input.

2. Connect Marked Card Programmer to mainframe rear panel connector J3.

3. Connect oscilloscope delayed sweep output through a BNC TEE to oscilloscope channel A vertical input and to Computing Counter rear panel external time measurement input.

4. Set counter controls as follows: rear panel switch to trigger; "B" channel to X1 sensitivity; module switch pressed to display digits for necessary resolution; measurement time to 1; counter gate time to 1 ms.

5. Program the System for 29.999 999 MHz.

6. Set oscilloscope controls as follows: Trigger, ac slow; ext, negative slope, trigger level at about 11:00 o'clock; Sweep Mode auto; Delay Trigger auto; Main Sweep 1 ms; Delay Sweep 0.05 μs; Main sweep mode.

7. Set oscilloscope trace to start at left vertical graticule line. Use oscilloscope delay control to delay spike 6 divisions from CRT left graticule line.

8. Switch oscilloscope sweep mode from auto to normal.

9. Program the system for 30.000 000 MHz. Frequency displayed on computing counter should be 30 MHz ± 50 Hz. Record the frequency.

   ________ MHz

10. Program the System for 29.999 999 MHz. Frequency displayed on counter should again be within ± 50 Hz of programmed frequency.

    ________ MHz

11. Set Oscilloscope normal sweep for 20 ms and delay sweep to 1 μs.

12. Set Oscilloscope sweep mode to auto and delay control for a delay spike at center vertical CRT graticule line.

13. Set Oscilloscope main trigger to normal and computing counter gate time to 100 ms.

14. Program the System for 30.000 000 MHz. Frequency displayed on computing counter should be within ± 5 Hz of programmed frequency

    ________ MHz

15. Program the System for 29.999 999 MHz. Frequency Displayed on computing counter should be within ± 5 Hz of programmed frequency.

    ________ MHz

PERFORMANCE TESTS

4-12. OUTPUT LEVEL SWITCHING TIME

SPECIFICATION:

Any level change may be accomplished in less than 50 ms. Any change to another level on the same attenuator range may be accomplished in 5 ms in REMOTE mode.

DESCRIPTION:

The Synthesized Signal Generator System RF OUTPUT level (attenuation) is remotely programmed while the RF OUTPUT is detected and monitored by an oscilloscope. Because the oscilloscope is triggered by the programming device, the time needed to effect the level change may be measured directly on the oscilloscope CRT.

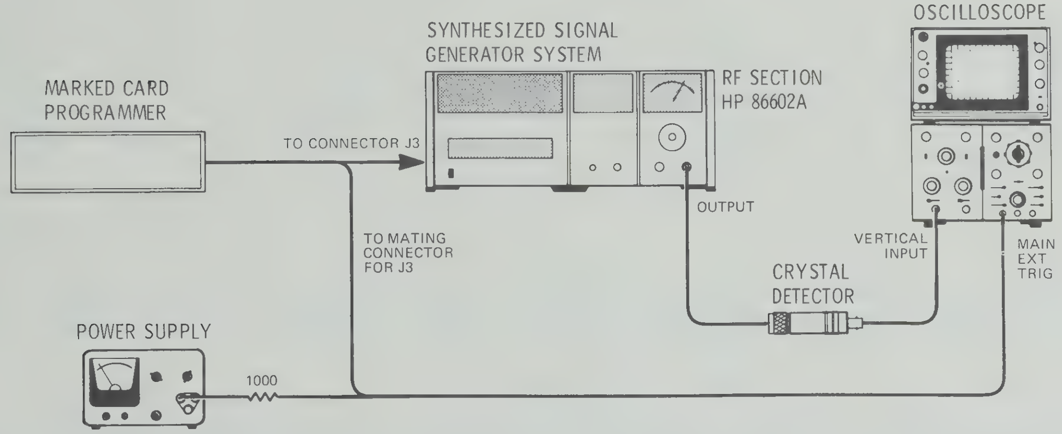


Figure 4-3. Output Level Switching Time Test Setup

EQUIPMENT:

Marked Card Programmer	HP 3260A
Oscilloscope	HP 180C/1801A/1821A
Crystal Detector	HP 8471A
Power Supply	HP 721A

PROCEDURE:

1. Connect equipment as illustrated in Figure 4-3. Note that +5 volt output from DC Power Supply is connected through a 1000 ohm resistor to pin 17 of mating connector to J3 and to Oscilloscope external trigger input.

2. Connect RF Section OUTPUT through crystal detector to oscilloscope Channel A input.

3. Set Oscilloscope controls as follows: Main Time/Div, 20 μs; Vertical input, dc coupled, 0.2 V/Div; Normal Sweep; Ext Trigger, negative slope, ACF, Trigger level about 11:00 o'clock.

4-12. OUTPUT LEVEL SWITCHING TIME (Cont'd)

4. Program the System's center frequency for 50 MHz and RF OUTPUT attenuation for following values: 0 dB, 5 dB, 9 dB. Switching time should be less than 5 ms. Record switching time.

0 dB ______ 5 ms

5 dB ______ 5 ms

9 dB ______ 5 ms

5. Program RF Section attenuation for 0 dB, then for 20 dB. Switching time should be less than 50 ms.
6. Repeat steps 4 and 5 with center frequency set to 1 MHz.

0 dB ______ 5 ms

5 dB ______ 5 ms

9 dB ______ 5 ms

0 to 20 dB ______ 20 ms

4-13. OUTPUT LEVEL AND ACCURACY

SPECIFICATION:

± 1.5 dB from +10 dBm to —76 dBm, and ± 2 dB from —77 dBm to —146 dBm. Output Level: +10 dBm to —146 dBm into 50 ohms.

DESCRIPTION:

The RF Output of the Synthesized Signal Generator System is attenuated by a calibrated external stepping attenuator (10 dB steps) and monitored by a spectrum analyzer. A reference is established on the analyzer CRT and the RF Section's OUTPUT RANGE switch is stepped through its ranges (increases attenuation of signal in 10 dB steps) while an equal reduction in attenuation is set on the external attenuator. In each RANGE, the relative change in output level is checked.

NOTE

All sections of the internal programmable attenuator are checked separately. In addition, the 10 dB, 20 dB, and 40 dB sections are checked in all possible combinations. The sum of the inaccuracies of the —60 dBm and —70 dBm tests should not exceed ± 2 dB.

EQUIPMENT:

Variable Coaxial Attenuator (calibrated)	HP H38-355D
Spectrum Analyzer	HP 8555A/8552B/140S

PERFORMANCE TESTS

4-13. OUTPUT LEVEL AND ACCURACY (Cont'd)

PROCEDURE:

1. Set the RF Section OUTPUT RANGE and VERNIER to +10 dBm.
2. Set mainframe center frequency to 30 MHz.
3. Connect the system OUTPUT to the Spectrum Analyzer RF Input through the Variable Coaxial Attenuator.
4. Set Spectrum Analyzer controls as follows:

8555A		8552B	
Frequency	500 MHz	Scan Time	20 mSec/Div.
Bandwidth	10 kHz	Log Ref. Level	as required
Scan Width	0.2 MHz/Div.	Display Mode	2 dB/Div.
Input Attenuation	0 dB	Video Filter	10 kHz

5. Set external attenuator for 80 dB attenuation and adjust Spectrum Analyzer for a convenient reference level.
6. Change external Attenuator to 70 dB and RF Section OUTPUT RANGE to 0 dBm. Spectrum Analyzer display should be within ± 1.5 dB of established reference level.

0 dBm range —1.5 ______________________ +1.5 dB

7. Continue decreasing attenuation of Attenuator and RF Section OUTPUT RANGE in 10 dB steps until OUTPUT RANGE is set to —70 dBm and Attenuator is set for 0 dB attenuation.

—10 dBm —1.5 ______ +1.5 dB

—20 dBm —1.5 ______ +1.5 dB

—30 dBm —1.5 ______ +1.5 dB

—40 dBm —1.5 ______ +1.5 dB

—50 dBm —1.5 ______ +1.5 dB

—60 dBm —1.5 ______ +1.5 dB

—70 dBm —1.5 ______ +1.5 dB

8. Set RF Section OUTPUT RANGE to —80 dBm and verify that established reference level changes by 10 ± 2 dB.

PERFORMANCE TESTS

4-14. OUTPUT FLATNESS

SPECIFICATION:

Output level variation with frequency is less than ± 1.0 dB across the entire frequency range.

DESCRIPTION:

After an output level reference is established, power level measurement are made at various frequencies across the range of the Synthesized Signal Generator System. The Output levels must fall within the limits specified.

EQUIPMENT:

Power Meter	HP 432A
Thermistor Mount	HP H55-478A
3-dB Attenuator	HP 8491A Opt 003

PROCEDURE:

1. Zero the Power Meter.

2. Set the Power Meter range switch to 10 dBm; set the RF Section OUTPUT RANGE Switch and VERNIER Control for an output level of +10 dBm.

3. Connect the RF Section OUTPUT to the Power Meter Thermistor Mount through a 3 dB attenuator.

4. Measure and record the power level indicated by the Power Meter at the following center frequencies: 1 MHz, 10 MHz, 100 MHz, 500 MHz and 1299 MHz.

1 MHz +6.0 ______ +8.0 dBm

10 MHz +6.0 ______ +8.0 dBm

100 MHz +6.0 ______ +8.0 dBm

500 MHz +6.0 ______ +8.0 dBm

1299 MHz +6.0 ______ +8.0 dBm

4-15. HARMONIC SIGNALS

SPECIFICATION:

All harmonically related signals are at least 30 dB below the desired output signal for output levels below +3 dBm. (—25 dB for output levels above +3 dBm.)

DESCRIPTION:

A spectrum analyzer is used to measure the relative levels of the second and third carrier harmonics with respect to the carrier fundamental at various frequencies.

EQUIPMENT:

Spectrum Analyzer	HP 8555A/8552B/140S

4-15. HARMONIC SIGNALS (Cont'd)

PROCEDURE:

1. Set RF Section OUTPUT RANGE switch and VERNIER control for an OUTPUT of +10 dBm.

2. Connect RF Section OUTPUT to Spectrum Analyzer RF Input.

3. Set system center frequency to 1299 MHz.

4. Set the Spectrum Analyzer controls to view the carrier signal and its second and third harmonics on the CRT. With the carrier fundamental signal, establish a reference on a convenient horizontal grid line. The harmonic levels should be ⩾ 25 dB down. Record the levels.

		Second	Third
1299 MHz	⩾25 dB down	______	______

5. Repeat step 4 at the other frequencies listed. Record the levels.

		Second	Third
1000 MHz	⩾25 dB down	______	______
500 MHz	⩾25 dB down	______	______
50 MHz	⩾25 dB down	______	______
10 MHz	⩾25 dB down	______	______

6. Set the system center frequency to 1299 MHz; the RF Section OUTPUT RANGE Switch to 0 dBm. Record the harmonic levels.

		Second	Third
1299 MHz	⩾30 dB down	______	______

4-16. PULSE MODULATION RISETIME

SPECIFICATION:

50 nanoseconds.

DESCRIPTION:

The external pulse generator output is coupled to the RF Section plug-in through the Model 86631B Auxiliary Section. The pulse modulated signal is detected and the rise time measured with an oscilloscope.

4-16. PULSE MODULATION RISETIME (Cont'd)

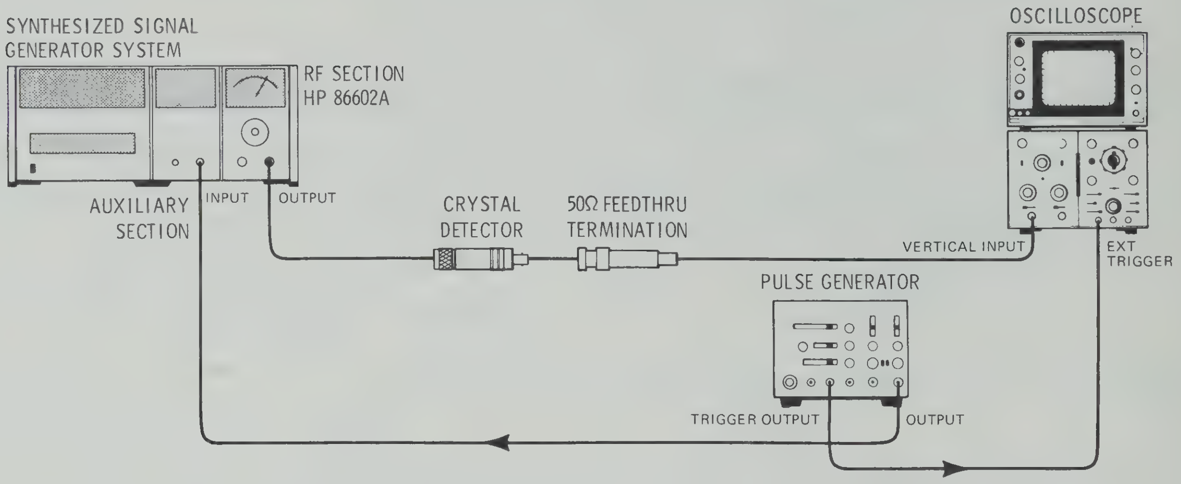


Figure 4-4. Pulse Modulation Risetime Test Setup

EQUIPMENT:

Pulse Generator	HP 8013A
Oscilloscope	HP 180C/1801A/1820C
Crystal Detector	HP 420A
Termination, 50Ω Feedthru	HP 11048C

PROCEDURE:

1. Set System center frequency to 500 MHz.

2. Set the RF Section OUTPUT RANGE switch and VERNIER control on output of +10 dBm.

3. Set Auxiliary Section external modulation switch to pulse; set pulse level control full cw.

4. Adjust pulse generator output for —10 Vpk with 10 ns risetime; set pulse repetition rate and width to convenient values.

5. Connect equipment as illustrated in Figure 4-4.

6. Adjust oscilloscope to display leading edge of detected pulse modulated RF signal. Risetime, as measured between the 10% and 90% amplitude points on leading edge, should be 50 nanoseconds or less.

______50 ns

PERFORMANCE TESTS

4-17. PULSE MODULATION ON/OFF RATIO

SPECIFICATION:

At least 40 dB (with Model 86631B modulation level control at maximum).

DESCRIPTION:

An HP Model 86631B Auxiliary Section is inserted in the left drawer of the Synthesized Signal Generator System while the RF Section OUTPUT is monitored by a spectrum analyzer. Carrier level measurements are taken with Auxiliary Section external modulation switch settings to Off (equivalent to pulse-on) and Pulse (equivalent to pulse-off without an external pulse input). The On/Off ratio is computed.

EQUIPMENT:

Spectrum Analyzer . . . . HP 8555A/8552B/140S

PROCEDURE:

1. Set System center frequency to 500 MHz, RF Section OUTPUT RANGE Switch and VERNIER control for an output level of +10 dBm, and Auxiliary Section external modulation switch to off.

2. Connect the RF Section OUTPUT to the Spectrum Analyzer RF input.

3. Adjust the analyzer controls for a CRT display of the 500 MHz carrier. Establish the reference by positioning the peak of the carrier envelope on the top horizontal graticule line.

4. Set the Auxiliary Section external modulation switch to PULSE. Carrier displayed on Spectrum Analyzer should be >40 dB down. Record the indication.

40 dB down ________

4-18. AMPLITUDE MODULATION DEPTH AND RATE

SPECIFICATION:

Depth: 0 to 90% on 0.3 volt (0 dBm) range and below.
Rate: DC to 500 kHz above 10 MHz carrier frequency; DC to 4 kHz below 10 MHz carrier frequency.

DESCRIPTION:

Amplitude modulation drive signals of various levels and frequencies are input to the RF Section through the Modulation or Auxiliary Sections. The AM mode sensitivity and frequency response is tested by measuring the RF Section amplitude modulated RF Output with a spectrum analyzer.

4-18. AMPLITUDE MODULATION DEPTH AND RATE (Cont'd)

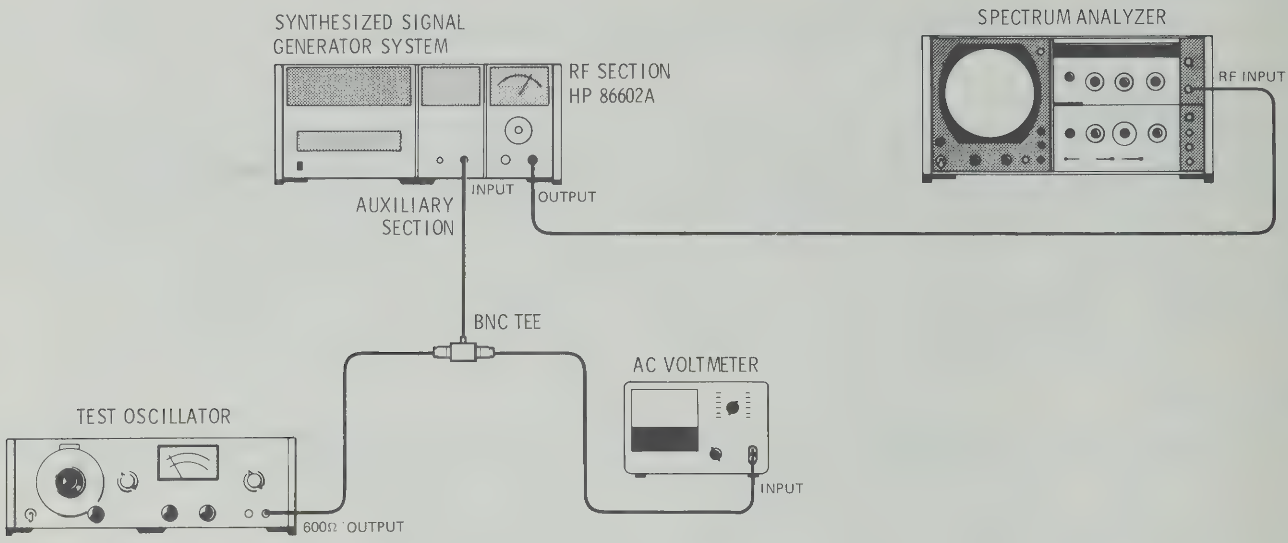


Figure 4-5. Amplitude Modulation Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 8555A/8552B/140S
AC Voltmeter	HP 403A
Test Oscillator	HP 651B
BNC Tee	UG 274B/U

PROCEDURE:

1. Set Synthesized Signal Generator System center frequency to 500 MHz; set RF Section OUTPUT RANGE switch and VERNIER control for an output level of 0 dBm.

2. Connect the equipment as shown in Figure 4-5.

3. Set the Spectrum Analyzer's input attenuation to 30 dB, resolution bandwidth to 1 kHz, frequency span to 10 kHz per division, center frequency to 500 MHz, vertical log sensitivity to 2 dB per division, display smoothing to off, sweep time to 20 ms per division. Adjust the vertical range and vernier controls to bring the peak of the carrier signal to the top horizontal graticule line.

4. Set the Modulation Section (Auxiliary Section) and Test Oscillator controls for a 10 kHz modulation signal. The modulation level control and/or the test oscillator output amplitude should be set for an amplitude modulation level of 50% (test oscillator output amplitude is 0.5 Vrms). Spectrum Analyzer should indicate sidebands 12.0 ± 0.5 dB down from carrier.

11.5____12.5 dB down

5 Set the modulation level to 30% (the test oscillator output is 0.3 Vrms). Sidebands should be 15.6 ± 0.5 dB down from carrier.

15.1____16.1 dB down

PERFORMANCE TESTS

4-18. AMPLITUDE MODULATION DEPTH AND RATE (Cont'd)

6. Set the modulation level to 90% (the test oscillator output is 0.9 Vrms). Side bands should be 7.0 ± 0.5 dB down from carrier.

6.5 ________ 7.5 dB down

7. Set the Spectrum Analyzer's input attenuation to 40 dB, center frequency to 10 MHz, and horizontal sweep time to 20 ms per division. Adjust the vertical range and vernier controls to bring the peak of the carrier signal to the top horizontal graticule line.

8. Set the Synthesized Signal Generator System's center frequency to 5 MHz and RF Section OUTPUT level to —10 dBm.

9. Set the Modulation Section (Auxiliary Section) and Test Oscillator for a modulation level of 30% (output of 0.3 Vrms from test oscillator) at 1 kHz.

10. Vary Test Oscillator output frequency from 1 to 10 kHz. The sideband output level as monitored on the Spectrum Analyzer CRT should be 15.6 ±0.4 dB down from carrier between 1 and 2 kHz; at 10 kHz the level should be less than 3 dB down (<18.6 dB down from carrier).

1 to 2 kHz 15.2 ____________ 16.0 dB down

at 10 kHz ____________ 18.6 dB down

11. Set the system center frequency to 500 MHz and the RF OUTPUT level to —10 dBm.

12. Set Test Oscillator output for 5 kHz at 0.3 Vrms.

13. Adjust Modulation Section (Auxiliary Section) controls for an amplitude modulation level of 30% (sidebands down 15.6 dB from carrier).

14. Vary Test Oscillator Output frequency from 5 to 100 kHz. The sideband output level as monitored on the spectrum analyzer CRT should be 15.6 ± 0.4 dB down from carrier between 5 and 20 kHz; at 100 kHz the level should be less than 3 dB down (18.6 dB down from carrier).

5 to 20 kHz 15.2 ____________ 16.0 dB down

100 kHz ____________ 18.6 dB down

PERFORMANCE TESTS

4-19. FREQUENCY MODULATION RATE AND DEVIATION

SPECIFICATION:

Rate: DC to 200 kHz
Deviation: DC to 200 kHz

DESCRIPTION:

A sinusoidal modulation drive signal is input from an external source to the Modulation Section and frequency modulates a 20 MHz VCO. The 20 MHz signal is mixed and processed through the system (in the FEM and RF Section) so the RF Output signal is also frequency modulated. The sensitivity and frequency response of the frequency modulation circuits are checked by monitoring the RF Output with a spectrum analyzer.

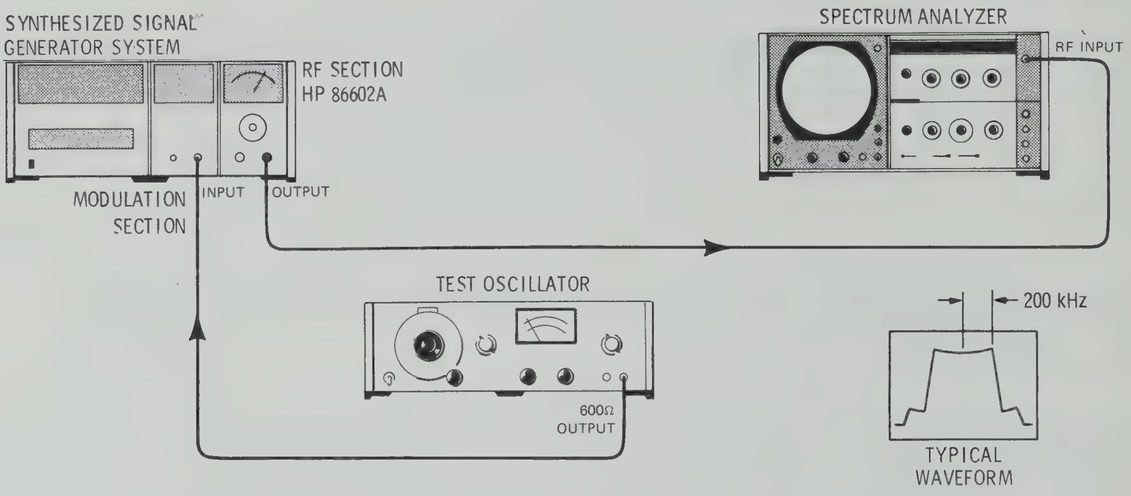


Figure 4-6. Frequency Modulation Rate and Deviation Test Setup

EQUIPMENT:

Test Oscillator	HP 651B
Spectrum Analyzer	HP 8555A/8552B/140S

PROCEDURE:

1. Set the Synthesized Signal Generator System's center frequency to 100 MHz and the RF Section's OUTPUT level to 0 dBm.

2. Connect the equipment together as illustrated in Figure 4-6.

3. Set the test oscillator output for 0.5 Vrms at 20 kHz.

4. Set the Modulation Section controls for external source, FM X 10 mode, and adjust the modulation level control for a front panel meter reading of 20 (200 kHz deviation).

PERFORMANCE TESTS

4-19. FREQUENCY MODULATION RATE AND DEVIATION (Cont'd)

5. Set the spectrum analyzer resolution bandwidth control to 300 kHz, frequency span to 0.2 MHz per division, center frequency to 100 MHz, and horizontal sweep time to 50 ms/division.
6. The bandwidth of the frequency modulated signal should be 400 kHz (200 kHz peak). Refer to typical waveform of Figure 4-6.

200 kHz - pk ________

7. Set the Modulation Section source control for an internal 1 kHz signal. The bandwidth of the FM signal should be 400 kHz (200 kHz - peak). Refer to typical waveform of Figure 4-6.

200 kHz - pk ________

4-20. OUTPUT IMPEDANCE

SPECIFICATION:

50 Ohms. SWR less than 2.0 on +10 dBm and 0 dBm ranges.
SWR less than 1.3 on —10 dBm range and below.

DESCRIPTION:

The RF Section is open-circuit and terminated (50Ω) output voltages are measured with a vector voltmeter. Source resistance and VSWR are calculated.

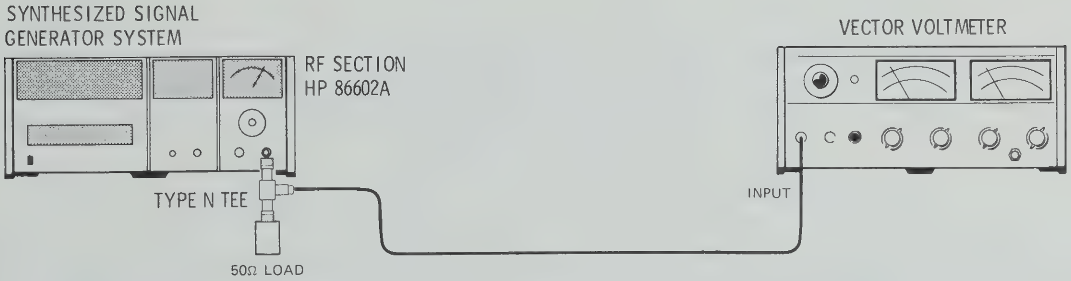


Figure 4-7. Output Impedance Test Setup

EQUIPMENT:

Vector Voltmeter	HP 8405A
Accessory Kit (50 Ohm Load and Tee)	HP 11570A

PROCEDURE:

1. Set mainframe center frequency to 50 MHz.
2. Set Model 86602A OUTPUT RANGE to 0 dBm and adjust VERNIER to 0 dB indication on meter.

4-20. OUTPUT IMPEDANCE (Cont'd)

3. Connect Model 86602A OUTPUT to Vector Voltmeter through type N Tee contained in Accessory Kit for Vector Voltmeter. Do not terminate type N Tee with 50 Ohm load.

4. Record the open circuit RF output voltage.

V_o =________Vrms

5. Connect a 50Ω load to the Type N Tee. Record the terminated RF output voltage.

V_T =________Vrms

6. Calculated the terminated source resistance using the following formula.

$$R_s = R_T (V_O/V_T) - R_T$$

Where: R_s is source resistance
R_T is termination load resistance
V_O is open circuit output voltage
V_T is terminated output voltage

R_s =________Ω

7. Calculate the SWR from the following formulas.

$$\text{If } R_T > R_s \text{ then SWR} = R_T/R_s$$

$$\text{or if } R_s > R_T \text{ then SWR} = R_s/R_T$$

Where: SWR is standing wave ratio
R_T is termination load impedance
R_s is source impedance.

SWR =________2.0

Repeat steps 3 through 9 after setting Model 86602A Output level to −10 dBm. Record R_s and SWR.

R_s ________Ω

SWR =________2.0

4-21. SIGNAL-TO-PHASE NOISE RATIO

SPECIFICATION:

Greater than 45 dB in a 30 kHz band centered on the signal, excluding a 1 Hz band centered on the carrier.

DESCRIPTION:

AC voltage measurements proportional to carrier amplitude and residual carrier phase deviation are compared for the signal-to-phase noise ratio. The Synthesized Signal Generator System's reference and RF OUTPUT (carrier) signals are mixed and the difference frequency is monitored by an oscilloscope and ac voltmeter. The mixer output (proportional to the carrier amplitude) is noted. The two signals are then frequency synchronized with phase difference of 180°. (This phase difference provides maximum resolution for voltage measurements at the mixer output which are proportional to the change of phase of the RF OUTPUT signal.) This ac voltage is proportional to the phase noise and when compared to the carrier voltage yields the signal-to-phase noise ratio.

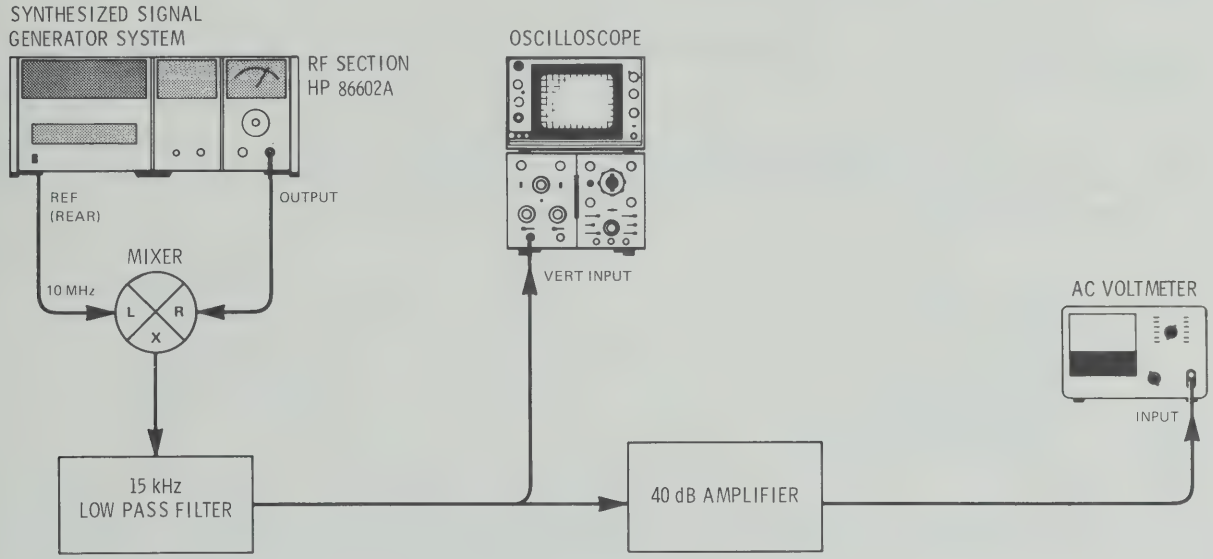


Figure 4-8. Signal-to-Phase Noise Ratio Test Setup

EQUIPMENT:

Oscilloscope	HP 180C/1801A/1821A
Double Balanced Mixer	HP 10514A
AC Voltmeter	HP 403A
40 dB Amplifier	(see Figure 1-2)
15 kHz Low Pass Filger	(see Figure 1-3)

PROCEDURE:

1. Interconnect equipment as illustrated in Figure 4-8.

2. Set mainframe center frequency to 10.001 MHz.

3. Set Model 86602A OUTPUT RANGE switch to —50 dBm and adjust VERNIER for meter indication of +3 on dB scale.

4-21. SIGNAL-TO-PHASE NOISE RATIO (Cont'd)

4. Set AC Voltmeter FUNCTION switch to 1 CPS — 1 MC and record relative AC voltmeter reading.

_______dB

5. Set mainframe center frequency to 10.000100 MHz and Model 86602A OUTPUT RANGE switch to —10 dBm.

6. Adjust oscilloscope display of 100 Hz signal for an amplitude of eight divisions.

7. Set mainframe center frequency to 10.000001 MHz and note that oscilloscope baseline trace alternately rises and falls over eight-division display. (10.0001 MHz; Option 004).

8. Reset mainframe center frequency to 10.000000 MHz at a time that causes oscilloscope baseline trace to stop at center horizontal line of graticule.

9. Repeat steps 7 and 8 until oscilloscope baseline trace stops within ± 1/10 division of center horizontal line of graticule.

10. Read noise level on AC Voltmeter. Signal-to-phase noise ratio = 40 dB — (± difference). Example: Meter reading is +8 dB below reference level. Signal-to-phase noise ratio = 40 — (—8) dB = 48 dB down. Record the ratio.

45 dB down ____________

4-22. SIGNAL-TO-AM NOISE RATIO

SPECIFICATION:

Greater than 65 dB in a 30 kHz bandwidth centered on carrier, excluding a 1 Hz bandwidth centered on the carrier.

DESCRIPTION:

AC voltage measurements proportional to carrier amplitude and residual AM noise are compared for Signal-to-AM Noise ratio. The Synthesized Signal Generator System's reference and RF OUTPUT (carrier) signals are mixed and the difference frequency is monitored by an oscilloscope and an ac voltmeter. The mixer OUTPUT (proportional to the carrier amplitude) is noted. The two signals are then frequency synchronized with a phase difference of 90° (this phase difference provides maximum resolution for voltage measurements at the mixer output which are proportional to the change in amplitude of the RF Output signal). This ac voltage is proportional to the AM noise level and when compared to the carrier amplitude yields the signal-to-AM noise ratio.

PERFORMANCE TESTS

4-22. SIGNAL-TO-AM NOISE RATIO (Cont'd)

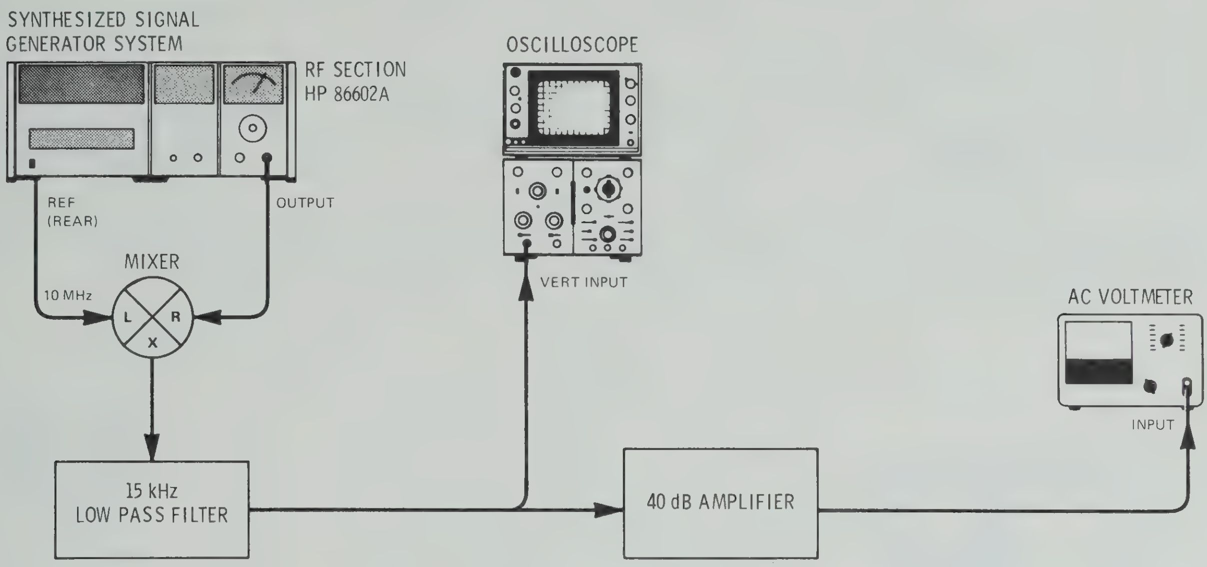


Figure 4-9. Signal-to-AM Noise Ratio Test Setup

EQUIPMENT:

Oscilloscope	HP 180C/1801A/1821A
Double Balanced Mixer	HP 10514A
AC Voltmeter	HP 403A
40 dB Amplifier	See Figure 1-2
15 kHz Low Pass Filter	See Figure 1-3

PROCEDURE:

1. Interconnect equipment as illustrated in Figure 4-9.

2. Set mainframe center frequency to 10.001000 MHz.

3. Set Model 86602A OUTPUT RANGE switch to —70 dBm and adjust VERNIER for meter indication of 0 on dB scale.

4. Set AC Voltmeter RANGE switch for on-scale reading, FUNCTION switch to 1 CPS — 1 MC, and record AC Voltmeter reading.

   ________dB

5. Set mainframe center frequency to 10.000100 MHz and Model 86602A OUTPUT RANGE switch to —10 dBm.

6. Adjust oscilloscope display of 100 Hz signal for an amplitude of eight divisions.

7. Set mainframe center frequency to 10.000001 MHz and note that oscilloscope baseline trace alternately rises and falls over eight-division display. (10.0001 MHz; Option 004).

4-22. SIGNAL-TO-AM NOISE RATIO (Cont'd)

8. Reset mainframe center frequency to 10.000000 MHz at a time that causes oscilloscope baseline trace to stop at top horizontal line of graticule.

9. Repeat steps 7 and 8 until oscilloscope baseline trace stops within ± 1/10 division of top horizontal line of graticule.

10. Read noise level on AC Voltmeter. Signal-to-AM Noise Ratio = 60 dB — (± difference in meter readings). See step 4. For example, meter reading is 6 dB lower than the reference level, therefore signal-to-AM Noise Ratio = 60 dB — (—6 dB) = 66 dB down from carrier level. Record the ratio.

65 dB down ____________

4-23. RESIDUAL FM

SPECIFICATION:

Less than 1.5 Hz rms in a 2 kHz bandwidth centered on carrier.

DESCRIPTION:

Because Residual FM and Phase Noise cannot be measured separately and because the Residual FM is the smaller part of the total measurement (≈1/4), this measurement is indirectly made in the Signal-to-Phase Noise Ratio test.

4-24. AMPLITUDE MODULATION CARRIER ENVELOPE DISTORTION

SPECIFICATION:

Envelope distortion should be less than 2% at 30% AM, 5% at 70% AM, and 10% at 90% AM.

DESCRIPTION:

The AM envelope distortion is the amplitude ratio of the sum of the sideband harmonics (second, third, fourth, etc.) with respect to the fundamental sideband. The CW outputs of the Synthesized Signal Generator System's are mixed, the difference frequency is passed through a low pass filter, and a reference level is established on the spectrum analyzer CRT. The two signals are frequency synchronized with a phase difference of 90°. (At the mixer output, this phase difference minimizes the effect phase or frequency deviation has on signal amplitude.) Next, a specific modulation level is set, the sideband amplitudes are measured, and the harmonics are compared to the fundamental. The ratio of the harmonics to fundamental is envelope distortion.

PERFORMANCE TESTS

4-24. AMPLITUDE MODULATION CARRIER ENVELOPE DISTORTION (Cont'd)

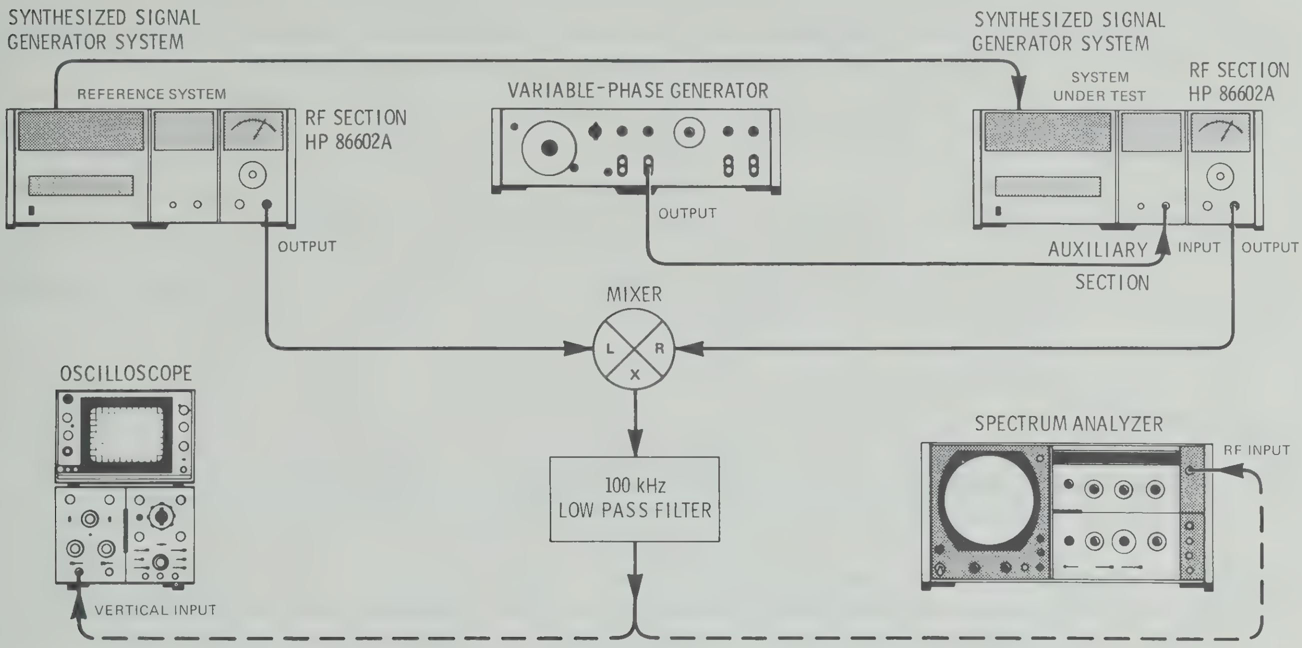


Figure 4-10. Amplitude Modulation Carrier Envelope Distortion Test Setup

EQUIPMENT:

Double Balanced Mixer	Relcom M1A-11
Spectrum Analyzer	HP 8553B/8552B/140S
Synthesized Signal Generator	HP 8660A/86602A/86631B
Variable Phase Generator	HP 203A
Oscilloscope	HP 180C/1801A/1821C
Low Pass Filter	See Figure 1-4

PROCEDURE:

1. Connect equipment as illustrated in Figure 4-10.

2. Connect rear panel REFERENCE OUTPUT from reference system to rear panel REFERENCE INPUT of system under test. Set REFERENCE SELECTOR of system under test to EXT.

3. On system under test, set mainframe center frequency to 1299.9 MHz, Model 86602A OUTPUT RANGE switch to −20 dBm, and adjust VERNIER for 0 dB indication on meter scale.

4. Connect Variable Phase Generator output to Auxiliary Section INPUT. Set Variable Phase Generator output to 10 kHz. Set Modulation (Auxiliary) Section to OFF.

5. On reference system set center frequency to 1299.91 MHz, Model 86602A OUTPUT RANGE switch to +10 dBm, and adjust VERNIER to 0 dB indication on meter scale.

6. Set oscilloscope for DC coupling and vertical sensitivity of 0.005V/Div.

PERFORMANCE TESTS

4-24. AMPLITUDE MODULATION CARRIER ENVELOPE DISTORTION (Cont'd)

7. Set Spectrum Analyzer as follows: INPUT ATTENUATION, 40 dB; SCAN WIDTH, 10 kHz/Div.; SCAN TIME, 20 mSec/Div.; BANDWIDTH, 1 kHz; and LOG SCALE, 10 dB/Div. Adjust Spectrum Analyzer vertical level until 10 kHz signal is positioned at LOG REF graticule line.

8. Adjust Oscilloscope for eight divisions of vertical deflection.

9. On reference system, set center frequency to 1299.900001 MHz. Note that Oscilloscope baseline trace alternately rises and falls over eight-division display. (1299.9001 MHz; Option 004).

10. On reference system, reset center frequency to 1299.900000 MHz at a time that causes oscilloscope baseline trace to stop at top horizontal graticule line.

11. Repeat steps 9 and 10 until oscilloscope baseline trace stops within ± 1/10 division of top horizontal graticule line.

12. Set Modulation (Auxiliary) Section controls for AM and adjust Variable Phase Generator output level until 10 kHz signal displayed on Spectrum Analyzer is 16.5 dB below reference level (30% AM).

13. *Using the carrier as reference* measure second, third, and fourth harmonics on Spectrum Analyzer. Use Table 4-1 to convert dB measurements into power ratios. Add power ratios and convert their sum back into dB by using Table 4-1. Total should be greater than 34 dB down from carrier level; about 2% of the fundamental sideband amplitude.

Example: Second Harmonic 45 dB = 0.32
Third Harmonic 45 dB = 0.32 ≈ 0.74 ≈ 41.5 dB down
Fourth Harmonic 50 dB - 0.10

Harmonic	Level	
	dB down	relative
Second	________	________
Third	________	________
Fourth	________	________
Total	________	________

14. Adjust Variable Phase Generator until 10 kHz fundamental is 9 dB below Spectrum Analyzer top graticule line reference (70% AM). Using the carrier reference, measure second, third, and fourth harmonics and use Table 4-1 as in step 10. Total harmonics should be greater than 26 dB down from carrier level; about 5% of the fundamental sideband amplitude.

PERFORMANCE TESTS

4-24. AMPLITUDE MODULATION CARRIER ENVELOPE DISTORTION (Cont'd)

Harmonic	Level	
	dB Down	relative
Second		
Third		
Fourth		
Total		

15. Adjust Variable Phase Generator until 10 kHz fundamental is 7 dB down Spectrum Analyzer top graticule line reference (90% AM). Using the carrier reference, measure second, third, and fourth harmonics and use Table 4-1 as in step 10. Total harmonics should be greater than 14 dB below 90% reference level or about 10% of the fundamental sideband amplitude.

Harmonic	Level	
	dB down	relative
Second		
Third		
Fourth		
Total		

Table 4-1. dB To Power Ratio Conversion

dB	Power Ratio X10^{-4}	dB	Power Ratio X10^{-4}	dB	Power Ratio X10^{-4}	dB	Power Ratio X10^{-4}
20	100.00000	33	5.01187	46	0.25119	59	.01259
21	79.43282	34	3.98107	47	0.19953	60	.01000
22	63.09573	35	3.16228	48	0.15849	61	.00794
23	50.11872	36	2.51189	49	0.12589	62	.00631
24	39.81072	37	1.99526	50	0.10000	63	.00501
25	31.62278	38	1.58489	51	.07943	64	.00398
26	25.11886	39	1.25893	52	.06310	65	.00316
27	19.95262	40	1.00000	53	.05012	66	.00251
28	15.84893	41	0.79433	54	.03981	67	.00200
29	12.58925	42	0.63096	55	.03162	68	.00158
30	10.00000	43	0.50119	56	.02512	69	.00126
31	7.94328	44	0.39811	57	.01995	70	.00100
32	6.30957	45	0.31623	58	.01585	71	.00079

PERFORMANCE TESTS

4-25. INCIDENTAL PHASE MODULATION

SPECIFICATION:

Less than 0.2 radians

DESCRIPTION:

The RF outputs of a reference system and the system under test are mixed and the difference frequency is monitored by an oscilloscope and a wave analyzer. The system under test is amplitude modulated at a specified modulation level. This level is the reference established on the wave analyzer. The modulation is turned off and the RF outputs and frequency synchronized with a phase difference of 180° (this phase difference provides maximum resolution for voltage measurements which are proportional to change in phase). The measured voltage (which is proportional to incidental PM) is compared to the amplitude modulation reference level.

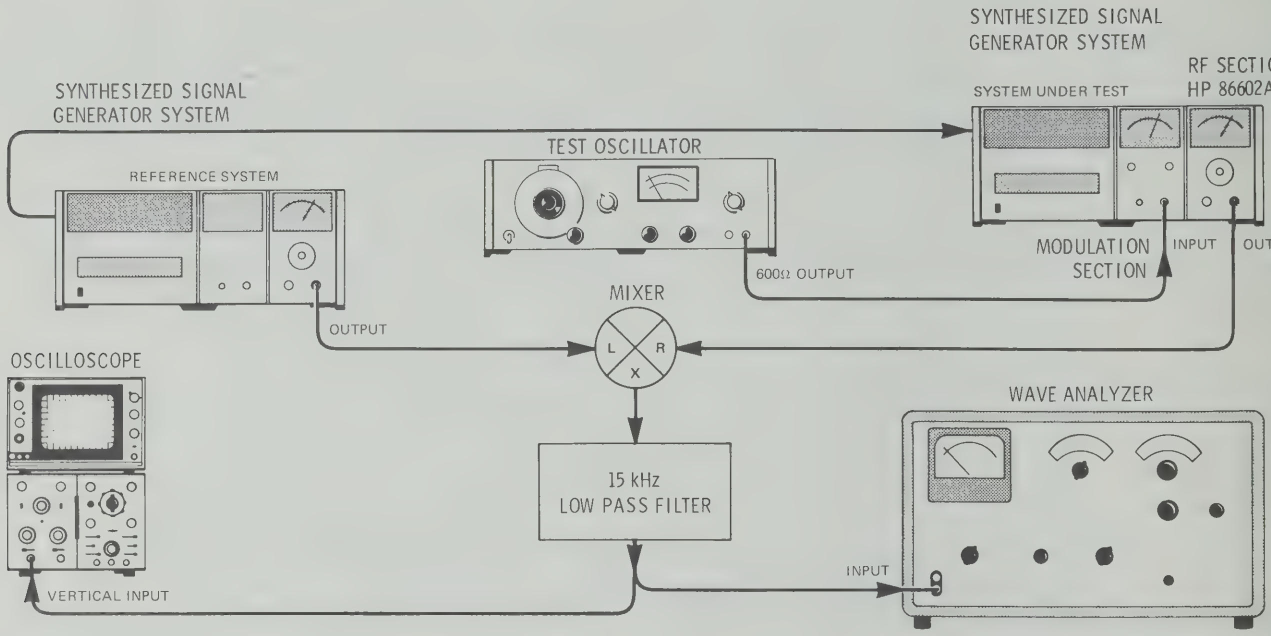


Figure 4-11. Incidental Phase Modulation Test Setup

EQUIPMENT:

Synthesized Signal Generator	HP 8660A/86602A/86631B
Oscilloscope	HP 180C/1801A/1821A
Test Oscillator	HP 651B
Wave Analyzer	HP 302A
Double Balanced Mixer	Relcom M1A-11
15 kHz Low Pass Filter	See Figure 1-3

PROCEDURE:

1. Connect equipment as illustrated in Figure 4-11.

2. Connect rear panel REFERENCE OUTPUT from reference system to rear panel REFERENCE INPUT of system under test. Set REFERENCE SELECTOR of unit under test to EXT.

PERFORMANCE TESTS

4-25. INCIDENTAL PHASE MODULATION (Cont'd)

3. Set oscilloscope for DC coupling, 0.01V/Div. vertical sensitivity, and 5 mSec/Div. horizontal sweep speed.

4. On system under test, set mainframe center frequency to 500 MHz, Model 86602A OUTPUT RANGE switch to −20 dBm, and adjust VERNIER for +3 dB indication on meter scale.

5. Connect Test Oscillator output to Modulation Section (Auxiliary Section) INPUT and set modulation mode switch to OFF.

6. Set Test Oscillator output frequency to 1 kHz.

7. On the reference system, set mainframe center frequency to 500.000100 MHz, Model 86602A OUTPUT RANGE switch to 0 dBm, and adjust VERNIER for +3 dB indication on meter scale.

8. Adjust oscilloscope for eight division vertical display of DC coupled 100 Hz signal.

9. On the reference system set mainframe center frequency to 500.000001 MHz. Note that oscilloscope baseline trace alternately rises and falls over eight-division display.

10. On reference system reset mainframe center frequency to 500.000000 MHz at a time that causes oscilloscope baseline trace to stop at top horizontal graticule line.

11. Repeat steps 9 and 10 until oscilloscope baseline trace stops within ± 1/10 division of top horizontal graticule line.

12. On system under test, set Modulation Section (Auxiliary Section) modulation mode control to AM.

13. With oscilloscope ac coupled, adjust Test Oscillator for a 2.4 division oscilloscope deflection (30% AM).

14. Set Wave Analyzer near 1 kHz to a peak and set a convenient 0 dB reference in relative mode (this is AM level).

15. On system under test, set Modulation Section (Auxiliary Section) modulation mode control to off.

16. On reference system set mainframe center frequency to 500.000001 MHz. Note that oscilloscope baseline trace alternately rises and falls over eight-division display. (500.0001 MHz; Option 004).

17. On reference system, reset mainframe center frequency to 500.000000 MHz at a time that causes oscilloscope baseline trace to stop at center horizontal graticule line.

18. Repeat steps 16 and 17 until oscilloscope baseline trace stops within ± 1/10 division of center horizontal graticule line.

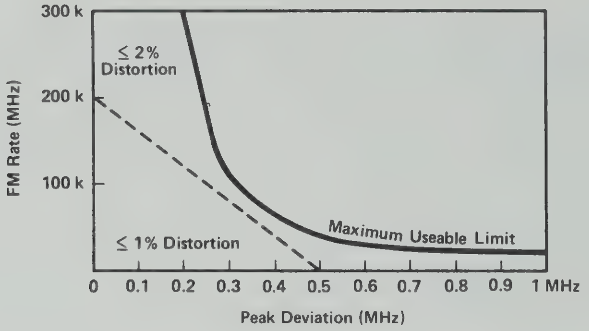
19. On system under test, set Auxiliary Section EXT. MODULATION switch to AM. Read PM level as indicated by Wave Analyzer. AM reference to PM ratio should be greater than 5 dB down.

5 dB________

PERFORMANCE TESTS

4-26. FREQUENCY MODULATION DISTORTION

SPECIFICATION:



86602A FM Distortion Curve

DESCRIPTION:

A test oscillator input is used to frequency modulate the RF OUTPUT of the Synthesized Signal Generator System. The output is connected to a frequency meter/FM discriminator. To eliminate the carrier, the signal is passed through a 100 kHz lowpass filter at a discriminator input. The amplitude of the first harmonic is established as the reference level on the wave analyzer. The levels of the second and third harmonics are measured and compared to the reference level to indicate the level of PM distortion.

NOTE

This procedure is valid if either the HP 86632A or 86633A is used. The instructions in italics apply only to the 86632A.

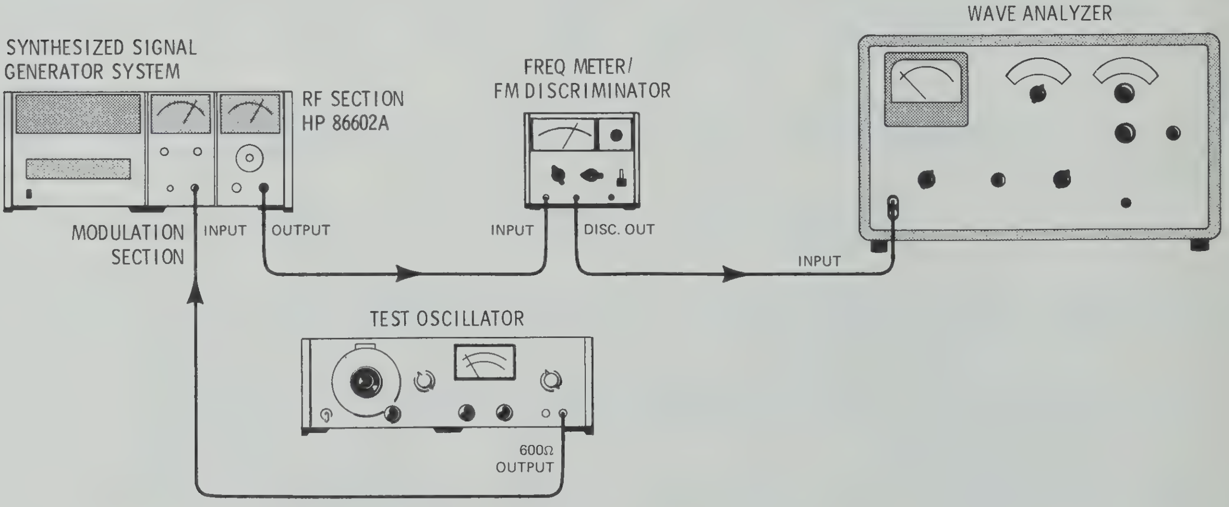


Figure 4-12. Frequency Modulation Distortion Test Setup

EQUIPMENT:

Frequency Meter/FM Discriminator	HP 5210A
Wave Analyzer	HP 302A
Test Oscillator	HP 651B

PERFORMANCE TESTS

4-26. FREQUENCY MODULATION DISTORTION (Cont'd)

PROCEDURE:

1. Connect equipment as illustrated in Figure 4-12.
2. Set Test Oscillator output for 10 kHz at 1.0 volt rms.
3. Set Modulation Section MODE swtich to FM X1 *or FM X10* and SOURCE switch to EXTERNAL AC. Adjust Modulation Section MODULATION LEVEL control for 200 kHz meter indication *and depress FM CF CAL button.*
4. Set mainframe center frequency to 8.5 MHz, Model 86602A OUTPUT RANGE switch to +10 dBm, and adjust VERNIER for 0 dB meter indication.
5. Install a 100 kHz low pass filter in Frequency Meter/FM Discriminator. (Refer to Frequency Meter/FM Discriminator Service Manual for details.)
6. Adjust Frequency Meter/FM Discriminator for 1 volt rms input sensitivity and 10 MHz range.
7. Set Wave Analyzer near 10 kHz and peak the reading (absolute). Wave Analyzer meter should indicate 14.4 millivolts rms (1 MHz - 200 millivolts p-p or 70.7 millivolts rms). Set Wave Analyzer to relative and adjust for a 0 dB reading.
8. Set Wave Analyzer near 20 kHz (second harmonic). Note dB reading on Wave Analyzer Meter.

   _______dB

9. Set Wave Analyzer near 30 kHz (third harmonic). Note dB reading on Wave Analyzer meter.

   _______dB

10. Use Table 4-1 to obtain power ratios for levels recorded in steps 8 and 9. Then, use Table 4-1 to find dB level corresponding to sum of the two ratios. The resultant level should be down ⩾ 34 dB from fundamental frequency level. Record resultant level.

    ⩾ 34 dB down ____________

PERFORMANCE TESTS

4-27. INCIDENTAL AM

SPECIFICATION:

With 75 kHz peak deviation at 1 kHz rate, AM modulation sidebands are down 60 dB from the fundamental.

DESCRIPTION:

The outputs of two Synthesized Signal Generator systems (which use the same time base reference) are mixed; the difference frequency is monitored by an oscilloscope and a wave analyzer. The level of this difference frequency is used to establish a reference on the wave analyzer. The two generator outputs are frequency synchronized 180° out of phase. (Because of this phase difference at the mixer output, the resolution of voltage measurements proportional to change in amplitude is maximum; minimum for measurements proportional to change in frequency.) The Systems RF Output is frequency modulated (as specified) and the relative incidental AM is measured.

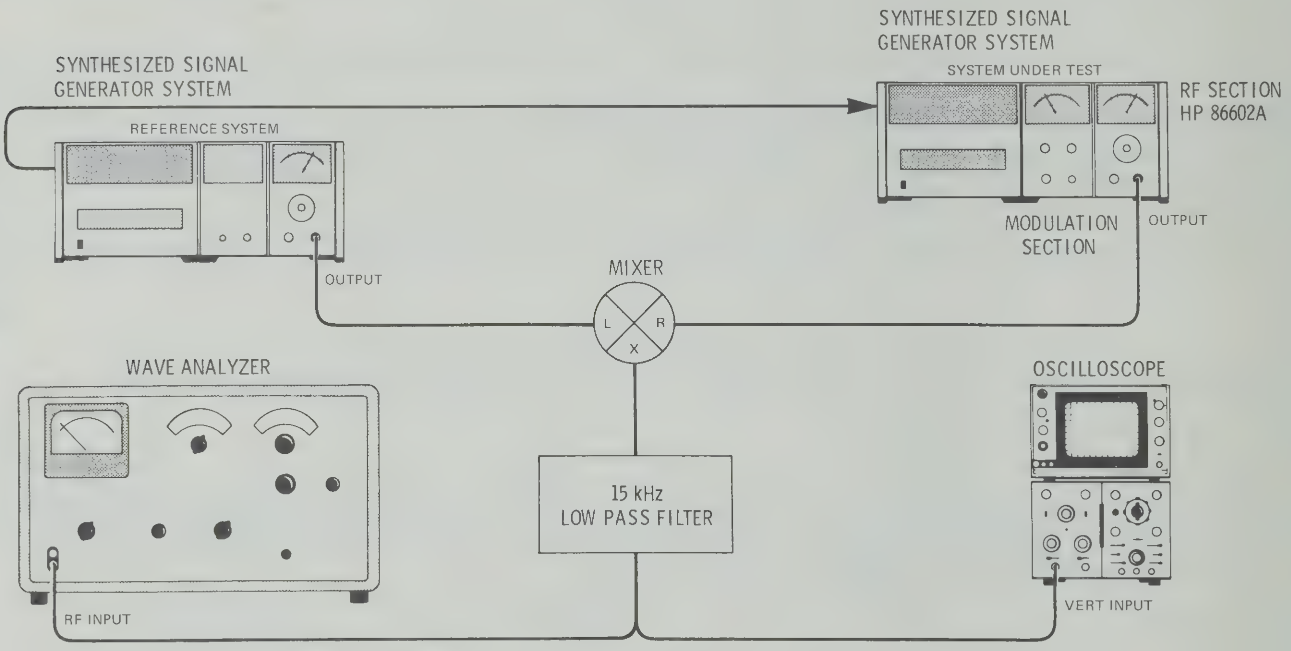


Figure 4-13. Incidental AM Test Setup

EQUIPMENT:

Synthesized Signal Generator	HP 8660A/86602A/86631B
Modulation Section	HP 86632A
Oscilloscope	HP 180C/1801A/1820A
Wave Analyzer	HP 302A
Double Balanced Mixer	Relcom M1A-11
15 kHz Low Pass Filter	See Figure 1-3

PROCEDURE:

1. Interconnect equipment as illustrated in Figure 4-13.

PERFORMANCE TESTS

4-27. INCIDENTAL AM (Cont'd)

2. Connect rear panel REFERENCE OUTPUT from reference system to rear panel REFERENCE INPUT of system under test. Set REFERENCE SELECTOR of system under test to EXT.
3. On system under test, set mainframe center frequency to 500 MHz, RF Section OUTPUT RANGE switch to −10 dBm, and adjust VERNIER to 0 dB meter indication.
4. On reference system, set mainframe center frequency to 500.001 MHz, RF Section OUTPUT RANGE switch to +10 dBm, and adjust VERNIER for 0 dBm meter indication.
5. Set Wave Analyzer near 1 kHz and peak meter indication. Set Wave Analyzer meter level to 0 dB in relative mode. Set oscilloscope for eight division deflection.
6. On reference system, set mainframe center frequency to 500.000001 MHz. Note that Oscilloscope baseline trace alternately rises and falls over eight-division display. (500.0001 MHz; Option 004).
7. On reference system, reset mainframe center frequency to 500.000000 MHz at a time that causes oscilloscope baseline trace to stop at top horizontal graticule line.
8. Repeat steps 6 and 7 until oscilloscope baseline trace stops within ± 1/10 division of top horizontal graticule line.
9. Set Modulation Section MODE switch to FM X1, SOURCE switch to 1000, and adjust MODULATION LEVEL control for a meter indication of 75 kHz deviation.
10. Note Wave Analyzer meter indication. Meter should indicate that incidental AM is greater than 60 dB down from reference level established in step 5.

60 dB down ____________

4-28. SPURIOUS SIGNALS, NARROWBAND

SPECIFICATION:

For selected output signals below 700 MHz, all nonharmonically related non-line spurious signals are at least 80 dB below the carrier. For selected signals above 700 MHz, all nonharmonically related non-line spurious signals are down 80 dB within 45 MHz of carrier. All power line related spurious signals are at least 70 dB down from carrier.

DESCRIPTION:

The outputs of two Synthesized Signal Generator Systems (which use the same time base reference) are mixed and the difference frequency is amplified and coupled to the wave analyzer. A reference level is established, various selected frequencies are then set on the two generator systems, and selected spurious signal levels are measured.

PERFORMANCE TESTS

4-28. SPURIOUS SIGNALS, NARROWBAND (Cont'd)

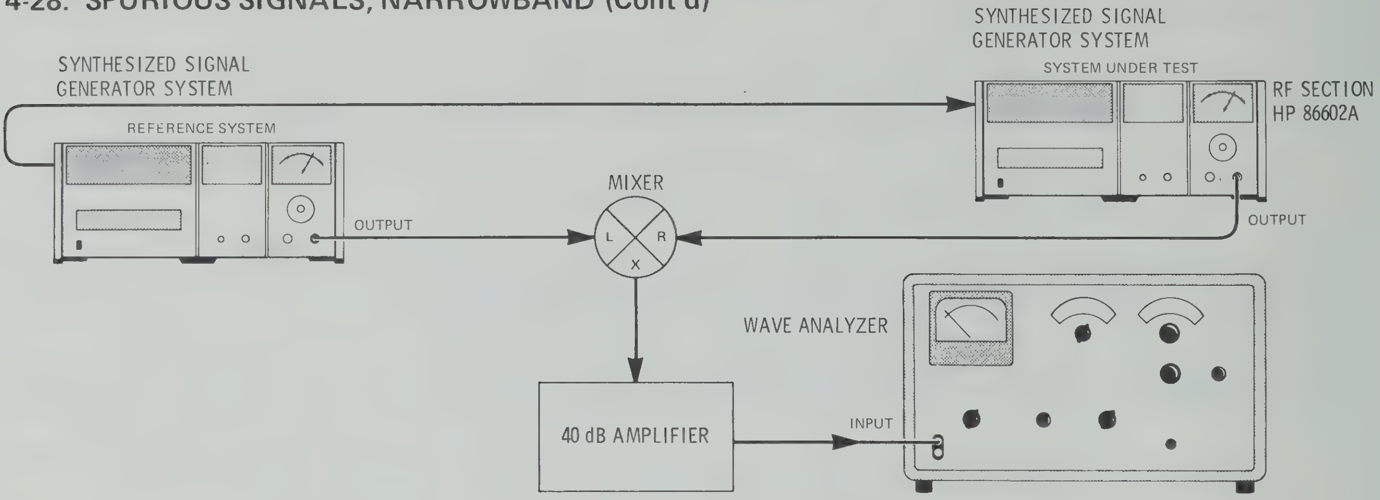


Figure 4-14. Narrowband Spurious Signal Test Setup

EQUIPMENT:

Synthesized Signal Generator	HP 8660A/86602A/86631B
Double Balanced Mixer	Relcom M1A-11
Wave Analyzer	HP 302A
40 dB Amplifier	See Figure 1-2

PROCEDURE:

1. Connect equipment as illustrated in Figure 4-14.

2. Connect rear panel REFERENCE OUTPUT from reference system to rear panel REFERENCE INPUT of system under test. Set REFERENCE SELECTOR of system under test to EXT.

3. On reference system, set mainframe center frequency to 500.001 MHz, Model 86602A OUTPUT RANGE switch to +10 dBm, and adjust VERNIER control to 0 dB indication on meter scale.

4. On system under test, set mainframe center frequency to 500 MHz, Model 86602A OUTPUT RANGE switch to —90 dBm, and adjust VERNIER control to 0 dB indication on meter scale.

5. Set Wave Analyzer MODE SELECTOR switch to NORMAL and SCALE VALUE switch to RELATIVE.

6. Set Wave Analyzer FREQUENCY control to 1 kHz and adjust levels for a 0 dB indication on meter scale.

7. On system under test, set OUTPUT RANGE switch to —10 dBm and adjust VERNIER for 0 dB indication on meter scale.

8. On reference system and system under test, set mainframe center frequency values to those listed in Table 4-2 and verify that levels of corresponding spurious signals are in accordance with specification (greater than 80 dB down from carrier). Corrected reading of spurious level relative to carrier is 80 dB — (± difference level), therefore level = 80 — (—3) dB = 83 dB down.

4-28. SPURIOUS SIGNALS, NARROWBAND (Cont'd)

NOTE

It may be necessary to slightly readjust the Wave Analyzer FREQUENCY control to locate the spurious signal.

Table 4-2. Narrowband Spurious Signals Checks

System Under Test	Reference System	Level Measured
100.280000 MHz	100.561000 MHz	______ dB down
200.180000 MHz	200.561000 MHz	______ dB down
409.720000 MHz	409.441000 MHz	______ dB down
509.710000 MHz	509.441000 MHz	______ dB down
1109.720000 MHz	1109.441000 MHz	______ dB down
1209.710000 MHz	1209.441000 MHz	______ dB down

4-29. SPURIOUS SIGNALS, WIDE BAND

SPECIFICATION:

For selected output signals above 700 MHz, all nonharmonically related non-line spurious signals, removed more than 45 MHz from the carrier, are down at least 50 dB from the carrier when the Model 86602A is operated with the OUTPUT RANGE switch in the 1 volt position, and 70 dB down on all other ranges.

DESCRIPTION:

The RF OUTPUT of the Synthesized Signal Generator System is monitored by a spectrum analyzer after being passed through a 2200 MHz lowpass filter. Selected signals which fall within the specified range are measured.

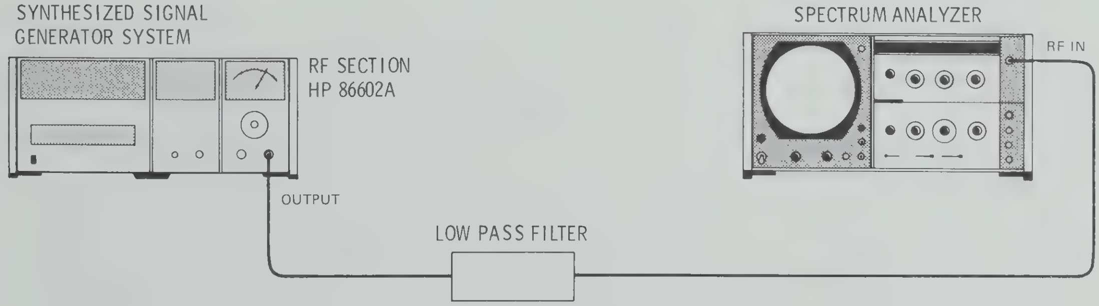


Figure 4-15. Wideband Spurious Signal Test Setup

EQUIPMENT:

Spectrum Analyzer . . . . HP 8555A/8552B/140S
Low Pass Filter (2200 MHz) . . . . HP 360C

4-29. SPURIOUS SIGNALS, WIDE BAND (Cont'd)

PROCEDURE:

1. Connect equipment as illustrated in Figure 4-15.
2. With Model 86602A OUTPUT RANGE switch set to +10 dBm and VERNIER control adjusted for 0 dB meter indication, set mainframe center frequency to values listed in Table 4-3 and adjust Spectrum Analyzer to measure corresponding spurious signal level below carrier. All spurious signal levels should be greater than 50 dB below carrier.

Table 4-3. Wideband Spurious Signals Checks

Mainframe Frequency	Spurious Frequency	Level Measured
1299.9 MHz	150 MHz	________ dB down
	1150 MHz	________ dB down
	1450 MHz	________ dB down
1000 MHz	950 MHz	________ dB down
	1050 MHz	________ dB down
999.9 MHz	950 MHz	________ dB down
	1050 MHz	________ dB down
800.0 MHz	750 MHz	________ dB down
799.9 MHz	850 MHz	________ dB down

Table 4-4. Performance Test Record (1 of 5)

Hewlett-Packard
Models 86602A/11661
RF Section/Frequency Extension Module

Tested By____________________

Serial No.____________________

Date____________________

Para. No.	Test	Results		
		Min.	Actual	Max.
4-9.	**FREQUENCY RANGE**			
	1.0 to 1299.999 999 MHz			
	Step 2 - 1.000 000 MHz	—1 Hz	________	+1 Hz
	Step 3 - 1299.999 999 MHz	—1 Hz	________	+1 Hz
4-11.	**FREQUENCY SWITCHING TIME**			
	6 ms to be within 50 Hz of any new frequency			
	Step 9 - 30.000 000 MHz ± 50 Hz	—50 Hz	________	+50 Hz
	Step 10 - 29.999 999 MHz ± 50 Hz	—50 Hz	________	+50 Hz
	100 ms to be within 5 Hz of any new frequency			
	Step 14 - 30.000 000 MHz ± 5 Hz	—5 Hz	________	+5 Hz
	Step 15 - 29.999 999 MHz ± 5 Hz	—5 Hz	________	+5 Hz
4-12.	**OUTPUT LEVEL SWITCHING TIME**			
	Remote programming of level change on same range accomplished in 5 ms, maximum, at 50 MHz.			
	Step 4 - 0 dB		________	5 ms
	5 dB		________	5 ms
	9 dB		________	5 ms
	Level change to another range accomplished in 50 ms, maximum, at 50 MHz.			
	Step 5 - 0 dB to 20 dB		________	50 ms
	Remote programming of level change on same range accomplished in 5 ms, maximum, at 1 MHz.			
	Step 6 - 0 dB		________	5 ms
	5 dB		________	5 ms
	9 dB		________	5 ms
	Level change to another range accomplished in 50 ms, maximum, at 1 MHz.			
	Step 6 - 0 dB to 20 dB		________	50 ms

Table 4-4. Performance Test Record (2 of 5)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-13.	OUTPUT LEVEL AND ACCURACY			
	Step 6 - 0 dBm range	—1.5 dB	________	+1.5 dB
	Step 7 - —10 dBm range	—1.5 dB	________	+1.5 dB
	—20 dBm range	—1.5 dB	________	+1.5 dB
	—30 dBm range	—1.5 dB	________	+1.5 dB
	—40 dBm range	—1.5 dB	________	+1.5 dB
	—50 dBm range	—1.5 dB	________	+1.5 dB
	—60 dBm range	—1.5 dB	________	+1.5 dB
	—70 dBm range	—1.5 dB	________	+1.5 dB
	Step 8 - —80 dBm range	—2 dB	________	+2 dB
4-14.	OUTPUT FLATNESS			
	Step 4 - 1 MHz	+6 dBm	________	+8 dBm
	10 MHz	+6 dBm	________	+8 dBm
	100 MHz	+6 dBm	________	+8 dBm
	500 MHz	+6 dBm	________	+8 dBm
	1299 MHz	+6 dBm	________	+8 dBm
4-15.	HARMONIC SIGNALS			
	OUTPUT RANGE = +10 dBm			
	Step 4 - 1299 MHz			
	Second Harmonic	25 dB down	________	
	Third Harmonic	25 dB down	________	
	Step 5 - 1000 MHz			
	Second Harmonic	25 dB down	________	
	Third Harmonic	25 dB down	________	
	Step 5 - 500 MHz			
	Second Harmonic	25 dB down	________	
	Third Harmonic	25 dB down	________	
	Step 5 - 50 MHz			
	Second Harmonic	25 dB down	________	
	Third Harmonic	25 dB down	________	
	Step 5 - 10 MHz			
	Second Harmonic	25 dB down	________	
	Third Harmonic	25 dB down	________	
	OUTPUT RANGE = 0 dBm			
	Step 6 - 1299 MHz			
	Second Harmonic	30 dB down	________	
	Third Harmonic	30 dB down	________	
4-16.	PULSE MODULATION RISETIME			
	Step 5 - Risetime (10% to 90% amplitude points)		________	50 ns

Table 4-4. Performance Test Record (3 of 5)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-17.	**PULSE MODULATION ON/OFF RATIO**			
	Step 5 - On/Off Ratio	40 dB	________	
4-18.	**AMPLITUDE MODULATION DEPTH AND RATE** Frequency = 500 MHz OUTPUT RANGE = 0 dBm Rate = 10 kHz			
	Step 4 - 50% AM	11.5 dB	________	12.5 dB down
	Step 5 - 30% AM	15.1 dB	________	16.1 dB down
	Step 6 - 90% AM	6.5 dB	________	7.5 dB down
	Frequency - 5 MHz OUTPUT RANGE = —10 dBm AM = 30%			
	Step 10 - 1 to 2 kHz Rate AM flat ± 0.4 dB	15.2	________	16.0 dB down from carrier
	Step 10 - AM less than 3 dB down at 10 kHz		________	18.6 dB down from carrier
	Frequency - 500 MHz OUTPUT RANGE = —10 dBm AM = 30%			
	Step 14 - 5 to 20 kHz rate AM flat ± 0.4 dB	15.2	________	16.0 dB down from carrier
	Step 14 - AM less than 3 dB down at 100 kHz		________	18.6 dB down from carrier
4-19.	**FREQUENCY MODULATION RATE AND DEVIATION** Deviation 200 kHz Frequency = 100 MHz Rate = 20 kHz OUTPUT RANGE = 0 dBm			
	Step 6 - Deviation produces 400 kHz display (200 kHz-pk)		________	
	Deviation = 200 kHz Frequency = 100 MHz Rate = 1 kHz OUTPUT RANGE - 0 dBm			
	Step 7 - Deviation produces 400 kHz display (200 kHz-pk)		________	

Table 4-4. Performance Test Record (4 of 5)

Para. No.	Test	Results		
		Min.	Actual	Max.
4-20.	**OUTPUT IMPEDANCE**			
	OUPUT RANGE = 0 dBm Frequency = 50 MHz			
	Step 7 - R_S		________	
	Step 9 - SWR		________	2.0:1
	OUTPUT RANGE = −10 dBm Frequency = 50 MHz			
	Step 10 - R_S		________	
	Step 11 - SWR		________	2.0:1
4-21.	**SIGNAL-TO-PHASE NOISE RATIO**			
	Step 11 - Noise Level	45 dB down	________	
4-22.	**SIGNAL-TO-AM NOISE RATIO**			
	Step 11 - Noise Level	65 dB down	________	
4-24.	**AMPLITUDE MODULATION CARRIER ENVELOPE DISTORTION**			
	30% AM Step 13 - Total Distortion (2%)	34 dB down	________	
	70% AM Step 14 - Total Distortion (5%)	26 dB down	________	
	90% AM Step 15 - Total Distortion (10%)	14 dB down	________	
4-25.	**INCIDENTAL PHASE MODULATION**			
	Step 19 - AM to FM Ratio	5 dB down	________	
4-26.	**FREQUENCY MODULATION DISTORTION**			
	Step 11 - Total Distortion	34 dB down	________	
4-27.	**INCIDENTAL AM**			
	Step 10 - Incidental AM	60 dB down	________	
4-28.	**SPURIOUS SIGNALS, NARROWBAND**			
	(All spurious signals down from carrier 80 dB, minimum.)			
	Step 8 - Spurious Response			

Table 4-4. Performance Test Record (5 of 5)

Para. No.	Test		Results		
			Min.	Actual	Max.
4-28.	SPURIOUS SIGNALS, NARROWBAND (Cont'd)				
	Unit Under Test	Reference Unit			
	100.280000 MHz	100.561000 MHz	80 dB down	________	
	200.280000 MHz	200.561000 MHz	80 dB down	________	
	409.720000 MHz	409.441000 MHz	80 dB down	________	
	509.720000 MHz	509.441000 MHz	80 dB down	________	
	1109.720000 MHz	1109.441000 MHz	80 dB down	________	
	1209.720000 MHz	1209.441000 MHz	80 dB down	________	
4-29.	SPURIOUS SIGNALS, WIDEBAND (All spurious signals down from carrier 50 dB, minimum.) Step 2 - Spurious Response				
	Mainframe Frequency	Spur Frequency			
	1299 MHz	150 MHz	50 dB down	________	
		1150 MHz	50 dB down	________	
		1450 MHz	50 dB down	________	
	1000 MHz	950 MHz	50 dB down	________	
		1050 MHz	50 dB down	________	
	999 MHz	950 MHz	50 dB down	________	
		1050 MHz	50 dB down	________	
	800 MHz	750 MHz	50 dB down	________	
	799 MHz	850 MHz	50 dB down	________	

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section contains adjustment procedures required to assure peak performance of the Model 86602A RF Section. The 86602A should be adjusted after any repair or if the unit, in conjunction with the Frequency Extension Module, fails to meet the specifications listed in Section IV of this manual. Prior to making any adjustments, allow the 86602A to warmup for 30 minutes.

5-3. The order in which adjustments are made to the 86602A is critical. Perform adjustments in sequence and under the conditions presented in this section. Do not attempt to make adjustments randomly to the instrument. Prior to making any adjustments to the Model 86602A, refer to the paragraph entitled Related Adjustments.

5-4. EQUIPMENT REQUIRED

5-5. Each adjustment procedure in this section contains a list of test equipment and accessories required to perform the adjustment. The test equipment is also identified by callouts in the test setup diagrams included with each procedure.

5-6. If substitutions must be made for the specified test equipment, refer to Table 1-2 for the minimum specifications of the test equipment to be used in the adjustment procedures. Since the Model 86602A is an extremely accurate instrument, it is particularly important that the test equipment used in the adjustment procedures meets the critical specifications listed in Table 1-2.

5-7. The HP 11672A Service Kit is an accessory item available from Hewlett-Packard for use in maintaining the Model 86602A RF Section. A detailed listing of the items contained in the service kit is provided in Table 1-2. Any item in the kit may be ordered separately.

5-8. SAFETY CONSIDERATIONS

5-9. Although this instrument has been designed in accordance with international safety standards, this manual and the system mainframe manual contain information, cautions, and warnings which must be followed to ensure safe operation and to retain the complete system in safe condition. Service adjustments should be performed only by qualified service personnel.

NOTE

Refer to the mainframe manual for safety information relating to ac line (Mains) voltage, fuses, protective earth grounding, etc.

5-10. Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

5-11. Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

WARNING

Adjustments described herein are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

5-12. RELATED ADJUSTMENTS

5-13. When making adjustments to the 86602A the RF Output Level adjustment should always be performed first. Next, perform the 1 dB Step Attenuator adjustment and then repeat the RF Output Level adjustment procedure. The RF Output Level adjustment procedure should always be repeated after the 1 dB Step Attenuator adjustment because an interaction exists between the two adjustments. After repeating the RF Output Level adjustment procedure, perform the AM Input Circuit adjustment procedure.

5-14. ADJUSTMENT LOCATIONS

5-15. The last foldout in this manual contains a table which cross-references all pictorial and schematic locations of the adjustable controls. The figure accompanying the table shows the locations of adjustable controls, assemblies, and chassis-mounted parts.

5-16. ADJUSTMENTS

5-17. Before adjustments to the RF Section can be performed, the mainframe (Mains) Power Cable must be disconnected, the RF Section must be removed from the mainframe, the RF Section covers must be removed, and the instrument must be connected to the mainframe with interconnection cables which are part of the HP 11672A Service Kit.

WARNING

The multi-pin plug connector (on mainframe), which provides interconnection to the RF Section, will expose power supply voltages which may remain on the pins after the RF Section is removed and after the (Mains) power cable is disconnected from the mainframe. Be careful to avoid contact with the pins during interconnection with RF Section.

ADJUSTMENTS

5-18. RF OUTPUT LEVEL ADJUSTMENT

REFERENCE:

Service Sheet 2

DESCRIPTION:

The Mtr and Detector Bias controls are adjusted alternately at specific RF Output levels until the VERNIER'S control of the RF Output is linear across the control range.

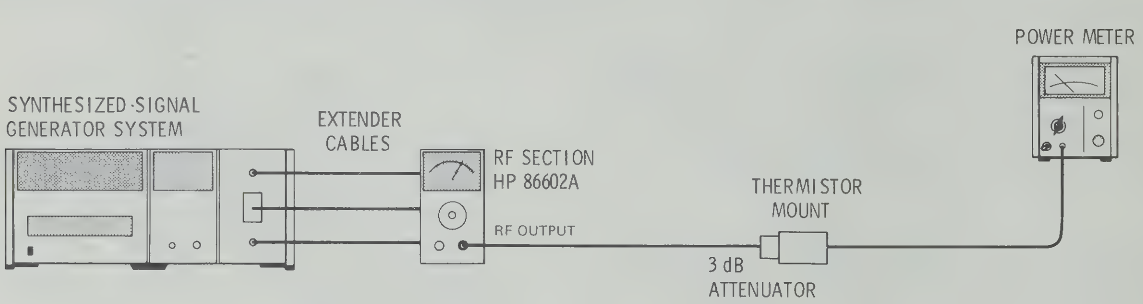


Figure 5-1. RF Output Level Adjustment Test Setup

EQUIPMENT:

Power Meter	HP 432A
Thermistor Mount	HP 478A
Extender Cables (part of HP 11672A)	HP 11672-60001 HP 11672-60005 HP 11672-60006
3 dB Attenuator	HP 8491A Opt 003

PROCEDURE:

NOTE

*Prior to performing the procedure, clean the meter face with anti-static glass cleaner.**

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*STATNUL" by Weston Instrument Inc., Newark, New Jersey

5-18. RF OUTPUT LEVEL ADJUSTMENT (Cont'd)

1. Zero external Power Meter.
2. Interconnect equipment as illustrated in Figure 5-1.
3. Set mainframe center frequency to 500 MHz and 86602A OUTPUT RANGE switch to 0 dBm position.
4. Adjust 86602A VERNIER control for a 0 dBm indication on external Power Meter.
5. Adjust MTR potentiometer A4R26 for a +3 dB indication on 86602A front panel meter.
6. Adjust 86602A VERNIER control for a 86602A front panel meter indication of —6 dB.
7. Adjust BIAS potentiometer A4R13 for a —9 dBm indication on external Power Meter.
8. Repeat steps 4 through 7 until 86602A front panel meter indicates power levels that are 3 ± 0.3 dB greater than external Power Meter indications with no further adjustment.

5-19. 1 dB STEP ATTENUATOR ADJUSTMENT

REFERENCE:

Service Sheet 3

DESCRIPTION:

RF Level and RF Linearity controls are adjusted alternately at specific RF Output levels until the programmed 1 dB step control of RF Output is linear across the range (10 dB).

ADJUSTMENTS

5-19. 1 dB STEP ATTENUATOR ADJUSTMENT (Cont'd)

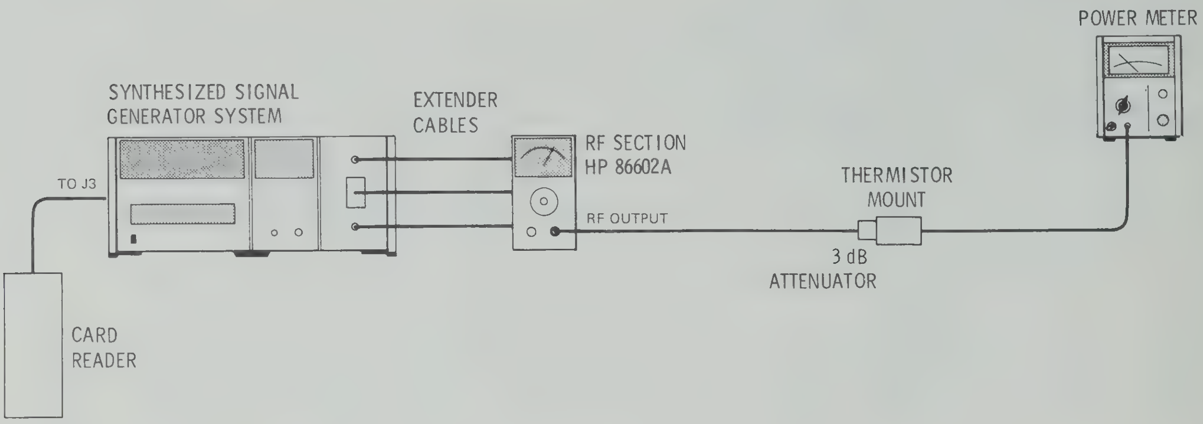


Figure 5-2. 1 dB Step Attenuator Adjustment Test Setup

EQUIPMENT:

Card Reader	HP 3260A Opt 001
Power Meter	HP 432A
Thermistor Mount	HP 478A
3 dB Attenuator Pad	HP 8491A Opt 003
Extender Cables (part of HP 11672A)	HP 11672-60001 HP 11672-60005 HP 11672-60006

PROCEDURE:

1. Connect equipment as illustrated in Figure 5-2.
2. Zero external Power Meter.
3. Use Card Reader to program mainframe for a center frequency value of 500 MHz and 86602A for an output power level of +3 dBm.
4. Adjust RF Level potentiometer A10R7 for a 0 dBm indication on external Power Meter.
5. Use Card Reader to program 86602A for an output power level of —6 dBm.
6. Adjust Linearity potentiometer A3R4 for a —9 dBm indication on external Power Meter.
7. Repeat steps 3 through 6 until 86602A RF OUTPUT power levels are 3 ± 0.3 dB greater than external Power Meter indications of +3 dBm and —6 dBm.
8. Perform RF Output Level Adjustment procedure (paragraph 5-13) again and then proceed to the AM Input Circuit Adjustment procedure (paragraph 5-16).

ADJUSTMENTS

5-20. AM INPUT CIRCUIT ADJUSTMENT

REFERENCE:

Service Sheet 3

DESCRIPTION:

A specific modulation drive level is coupled to the RF Section while the RF Output is monitored by a spectrum analyzer. The AM Cal and AM Linearity controls are adjusted alternately at specific output levels until the modulation level remains constant with any change in RF level.

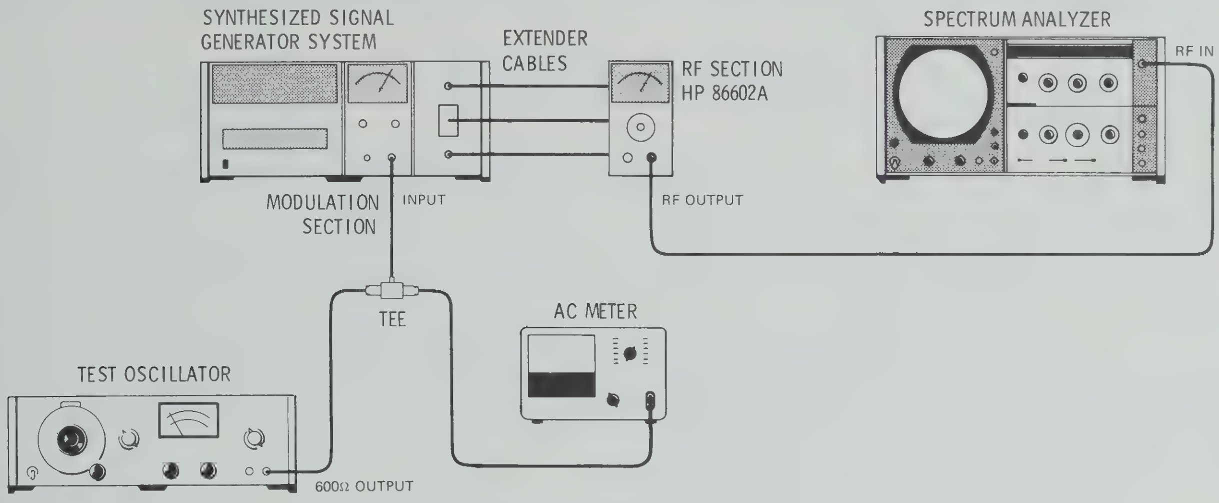


Figure 5-3. AM Input Circuit Adjustment Test Setup

EQUIPMENT:

Spectrum Analyzer	HP 8555A/8552B/140S
Test Oscillator	HP 651B
AC Meter	HP 403A
Exterder Cables (part of HP 11672A)	HP 11672-60001 HP 11672-60005 HP 11672-60006

PROCEDURE:

1. Connect equipment as illustrated in Figure 5-3.

2. Set mainframe center frequency to 500 MHz, 86602A OUTPUT RANGE switch to 0 dBm and adjust VERNIER for a +3 dB meter indication.

3. Adjust Spectrum Analyzer as follows: FREQUENCY, 500 MHz; BANDWIDTH, 1 kHz; SCAN WIDTH, 10 kHz/Div.; INPUT ATTENUATION, 30 dB; DISPLAY MODE, 2 dB/Div.; SCAN TIME, 20 mSec/Div.; VIDEO FILTER, OFF; LOG REF, set carrier at LOG REF graticule line.

4. When Modulation Section is used, set SOURCE and MODE controls to EXTERNAL AC, AM MODE.

5. Connect Test Oscillator 600 Ohm output, via a Tee connector, to AC Meter and external INPUT connector of Auxiliary, or Modulation Section.

5-20. AM INPUT CIRCUIT ADJUSTMENT (Cont'd)

6. Set Test Oscillator output frequency to 10 kHz and adjust output level for a 0.5 volt rms indication on AC Meter. If Modulation Section is used, adjust MODULATION LEVEL control for 50% modulation as indicated on Modulation Section front panel meter.

7. Adjust AM CAL potentiometer A10R5 until AM sidebands displayed on Spectrum Analyzer are down 12 ± 0.2 dB from carrier.

8. Adjust 86602A VERNIER for a —6 dB meter indication. Set Spectrum Analyzer to a convenient reference level.

9. Adjust AM Linearity potentiometer A10R2 until AM sidebands displayed on Spectrum Analyzer are down 12 ± 0.2 dB from carrier.

10. Adjust 86602A VERNIER for a +3 dB meter indication. Set Spectrum Analyzer to a convenient reference level.

11. Readjust AM CAL potentiometer A10R5 until AM sidebands displayed on Spectrum Analyzer are down 12 ± 0.2 dB from carrier.

12. Repeat steps 8 through 11 until AM sidebands are down 12 ± 0.2 dB from carrier without further adjustment.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. Table 6-1 lists abbreviations used in the parts list and throughout the manual. Table 6-2 lists all replaceable parts in reference designator order. Table 6-3 contains the names and addresses that correspond to the manufacturer's code numbers.

6-3. EXCHANGE ASSEMBLIES

6-4. The A13 Attenuator Assembly may be replaced on an exchange basis, thus affording considerable costs savings. Exchange, factory-repaired and tested assemblies are available only on a trade-in basis; therefore, the defective assemblies must be returned for credit. For this reason, assemblies required for spare parts stock must be ordered by the new assembly part number. The A13 assembly exchange part number is 86601-60109.

6-5. ABBREVIATIONS

6-6. Table 6-1 gives a list of abbreviations used in the parts list, schematics, and throughout the manual. In some cases, two forms of the abbreviation are given, one all capital letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower care and upper case letters.

6-7. REPLACEABLE PARTS

6-8. Table 6-2 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alpha-numerical order by reference designation.

b. Chassis-mounted parts in alpha-numeric order by reference designation.

c. Miscellaneous parts.

The information given for each part consists of the following:

a. The Hewlett-Packard part number.

b. The total quantity (Qty) found in the instrument.

c. The description of the part.

d. Typical manufacturer of the part in a five-digit code.

e. Manufacturer code number for the part.

The total quantity for each part is given only once — at the first appearance of the part number in the list.

6-9. ORDERING INFORMATION

6-10. To order a part listed in the replaceable Parts table, quote the Hewlett-Packard part number, indicate quantity required, and address the order to the nearest Hewlett-Packard office.

6-11. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

6-12. PARTS PROVISIONING

6-13. Stocking spare parts for an instrument is often done to insure quick return to service after a malfunction occurs. Hewlett-Packard has a "Spare Parts Kit" available for this purpose. The kit consists of selected replaceable assemblies and components for this instrument. The contents of the kit and the "Recommended Spares" list are based on failure reports and repair data, and parts support for one year. A complimentary "Recommended Spares" list for this instrument may be obtained on request and the "Spare Parts Kit" may be ordered through your nearest Hewlett-Packard office.

Table 6-1. Reference Designations and Abbreviations (1 of 2)

REFERENCE DESIGNATIONS

A	assembly
AT	attenuator; isolator; termination
B	fan; motor
BT	battery
C	capacitor
CP	coupler
CR	diode; diode thyristor; varactor
DC	directional coupler
DL	delay line
DS	annunciator; signaling device (audible or visual); lamp; LED
E	miscellaneous electrical part
F	fuse
FL	filter
H	hardware
HY	circulator
J	electrical connector (stationary portion); jack
K	relay
L	coil; inductor
M	meter
MP	miscellaneous mechanical part
P	electrical connector (movable portion); plug
Q	transistor: SCR; triode thyristor
R	resistor
RT	thermistor
S	switch
T	transformer
TB	terminal board
TC	thermocouple
TP	test point
U	integrated circuit; microcircuit
V	electron tube
VR	voltage regulator; breakdown diode
W	cable; transmission path; wire
X	socket
Y	crystal unit (piezo-electric or quartz)
Z	tuned cavity; tuned circuit

ABBREVIATIONS

A	ampere
ac	alternating current
ACCESS	accessory
ADJ	adjustment
A/D	analog-to-digital
AF	audio frequency
AFC	automatic frequency control
AGC	automatic gain control
AL	aluminum
ALC	automatic level control
AM	amplitude modulation
AMPL	amplifier
APC	automatic phase control
ASSY	assembly
AUX	auxiliary
avg	average
AWG	American wire gauge
BAL	balance
BCD	binary coded decimal
BD	board
BE CU	beryllium copper
BFO	beat frequency oscillator
BH	binder head
BKDN	breakdown
BP	bandpass
BPF	bandpass filter
BRS	brass
BWO	backward-wave oscillator
CAL	calibrate
ccw	counter-clockwise
CER	ceramic
CHAN	channel
cm	centimeter
CMO	cabinet mount only
COAX	coaxial
COEF	coefficient
COM	common
COMP	composition
COMPL	complete
CONN	connector
CP	cadmium plate
CRT	cathode-ray tube
CTL	complementary transistor logic
CW	continuous wave
cw	clockwise
cm	centimeter
D/A	digital-to-analog
dB	decibel
dBm	decibel referred to 1 mW
dc	direct current
deg	degree (temperature interval or difference)
°	degree (plane angle)
°C	degree Celsius (centigrade)
°F	degree Fahrenheit
°K	degree Kelvin
DEPC	deposited carbon
DET	detector
diam	diameter
DIA	diameter (used in parts list)
DIFF AMPL	differential amplifier
div	division
DPDT	double-pole, double-throw
DR	drive
DSB	double sideband
DTL	diode transistor logic
DVM	digital voltmeter
ECL	emitter coupled logic
EMF	electromotive force
EDP	electronic data processing
ELECT	electrolytic
ENCAP	encapsulated
EXT	external
F	farad
FET	field-effect transistor
F/F	flip-flop
FH	flat head
FIL H	fillister head
FM	frequency modulation
FP	front panel
FREQ	frequency
FXD	fixed
g	gram
GE	germanium
GHz	gigahertz
GL	glass
GRD	ground(ed)
H	henry
h	hour
HET	heterodyne
HEX	hexagonal
HD	head
HDW	hardware
HF	high frequency
HG	mercury
HI	high
HP	Hewlett-Packard
HPF	high pass filter
HR	hour (used in parts list)
HV	high voltage
Hz	Hertz
IC	integrated circuit
ID	inside diameter
IF	intermediate frequency
IMPG	impregnated
in	inch
INCD	incandescent
INCL	include(s)
INP	input
INS	insulation
INT	internal
kg	kilogram
kHz	kilohertz
kΩ	kilohm
kV	kilovolt
lb	pound
LC	inductance-capacitance
LED	light-emitting diode
LF	low frequency
LG	long
LH	left hand
LIM	limit
LIN	linear taper (used in parts list)
lin	linear
LK WASH	lock washer
LO	low; local oscillator
LOG	logarithmic taper (used in parts list)
log	logrithm(ic)
LPF	low pass filter
LV	low voltage
m	meter (distance)
mA	milliampere
MAX	maximum
MΩ	megohm
MEG	meg (10^6) (used in parts list)
MET FLM	metal film
MET OX	metallic oxide
MF	medium frequency; microfarad (used in parts list)
MFR	manufacturer
mg	milligram
MHz	megahertz
mH	millihenry
mho	mho
MIN	minimum
min	minute (time)
'	minute (plane angle)
MINAT	miniature
mm	millimeter

NOTE

All abbreviations in the parts list will be in upper-case.

Table 6-1. Reference Designations and Abbreviations (2 of 2)

MOD	modulator
MOM	momentary
MOS	metal-oxide semiconductor
ms	millisecond
MTG	mounting
MTR	meter (indicating device)
mV	millivolt
mVac	millivolt, ac
mVdc	millivolt, dc
mVpk	millivolt, peak
mVp-p	millivolt, peak-to-peak
mVrms	millivolt, rms
mW	milliwatt
MUX	multiplex
MY	mylar
μA	microampere
μF	microfarad
μH	microhenry
μmho	micromho
μs	microsecond
μV	microvolt
μVac	microvolt, ac
μVdc	microvolt, dc
μVpk	microvolt, peak
μVp-p	microvolt, peak-to-peak
μVrms	microvolt, rms
μW	microwatt
nA	nanoampere
NC	no connection
N/C	normally closed
NE	neon
NEG	negative
nF	nanofarad
NI PL	nickel plate
N/O	normally open
NOM	nominal
NORM	normal
NPN	negative-positive-negative
NPO	negative-positive zero (zero temperature coefficient)
NRFR	not recommended for field replacement
NSR	not separately replaceable
ns	nanosecond
nW	nanowatt
OBD	order by description
OD	outside diameter
OH	oval head
OP AMPL	operational amplifier
OPT	option
OSC	oscillator
OX	oxide
oz	ounce
Ω	ohm
P	peak (used in parts list)
PAM	pulse-amplitude modulation
PC	printed circuit
PCM	pulse-code modulation; pulse-count modulation
PDM	pulse-duration modulation
pF	picofarad
PH BRZ	phosphor bronze
PHL	Phillips
PIN	positive-intrinsic-negative
PIV	peak inverse voltage
pk	peak
PL	phase lock
PLO	phase lock oscillator
PM	phase modulation
PNP	positive-negative-positive
P/O	part of
POLY	polystyrene
PORC	porcelain
POS	positive; position(s) (used in parts list)
POSN	position
POT	potentiometer
p-p	peak-to-peak
PP	peak-to-peak (used in parts list)
PPM	pulse-position modulation
PREAMPL	preamplifier
PRF	pulse-repetition frequency
PRR	pulse repetition rate
ps	picosecond
PT	point
PTM	pulse-time modulation
PWM	pulse-width modulation
PWV	peak working voltage
RC	resistance-capacitance
RECT	rectifier
REF	reference
REG	regulated
REPL	replaceable
RF	radio frequency
RFI	radio frequency interference
RH	round head; right hand
RLC	resistance-inductance-capacitance
RMO	rack mount only
rms	root-mean-square
RND	round
ROM	read-only memory
R&P	rack and panel
RWV	reverse working voltage
S	scattering parameter
s	second (time)
..."	second (plane angle)
S-B	slow-blow (fuse) (used in parts list)
SCR	silicon controlled rectifier; screw
SE	selenium
SECT	sections
SEMICON	semiconductor
SHF	superhigh frequency
SI	silicon
SIL	silver
SL	slide
SNR	signal-to-noise ratio
SPDT	single-pole, double-throw
SPG	spring
SR	split ring
SPST	single-pole, single-throw
SSB	single sideband
SST	stainless steel
STL	steel
SQ	square
SWR	standing-wave ratio
SYNC	synchronize
T	timed (slow-blow fuse)
TA	tantalum
TC	temperature compensating
TD	time delay
TERM	terminal
TFT	thin-film transistor
TGL	toggle
THD	thread
THRU	through
TI	titanium
TOL	tolerance
TRIM	trimmer
TSTR	transistor
TTL	transistor-transistor logic
TV	television
TVI	television interference
TWT	traveling wave tube
U	micro (10^{-6}) (used in parts list)
UF	microfarad (used in parts list)
UHF	ultrahigh frequency
UNREG	unregulated
V	volt
VA	voltampere
Vac	volts, ac
VAR	variable
VCO	voltage-controlled oscillator
Vdc	volts, dc
VDCW	volts, dc, working (used in parts list)
V(F)	volts, filtered
VFO	variable-frequency oscillator
VHF	very-high frequency
Vpk	volts, peak
Vp-p	volts, peak-to-peak
Vrms	volts, rms
VSWR	voltage standing wave ratio
VTO	voltage-tuned oscillator
VTVM	vacuum-tube voltmeter
V(X)	volts, switched
W	watt
W/	with
WIV	working inverse voltage
WW	wirewound
W/O	without
YIG	yttrium-iron-garnet
Z_o	characteristic impedance

NOTE

All abbreviations in the parts list will be in upper-case.

MULTIPLIERS

Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	86602-60002	2	BOARD ASSY, MOD FILTER	28480	86602-60002
A1C1 †	0160-3847	1	CAPACITOR-FXD .01UF +100-0% 25WVDC CER	28480	0160-3847
A1J1	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A1J2	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A1L1	9140-0158	2	COIL, FXD, MOLDED RF CHOKE, 1UH 10%	24226	10/101
A1L2	9140-0158		COIL, FXD, MOLDED RF CHOKE, 1UH 10%	24226	10/101
A1L3 †	9100-2247	1	COIL; FXD; MOLDED RF CHOKE; .1UH 10%	24226	10/100
A1MP1	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A1P1	1251-3172	5	CONNECTOR;1-CONT SKT .03 DIA	00779	2-331677-9
A1P2	1251-3172		CONNECTOR;1-CONT SKT .03 DIA	00779	2-331677-9
A1P3	1251-3172		CONNECTOR;1-CONT SKT .03 DIA	00779	2-331677-9
A1P4	1251-3172		CONNECTOR;1-CONT SKT .03 DIA	00779	2-331677-9
A1P5	1251-3172		CONNECTOR;1-CONT SKT .03 DIA	00779	2-331677-9
A2	86602-60005	1	BOARD ASSY, MOTHER ALC	28480	86602-60005
A2C1	0160-2204	2	CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A2C2	0160-3457	1	CAPACITOR-FXD 2000PF +-10% 250WVDC CER	28480	0160-3457
A2J1	1250-1255	1	CONNECTOR-COAX; SMB; 50 OHM MALE	98291	51-051-0000
A2K1	0490-0916	9	RELAY; REED; 1A .5A 50V CONT; 5V COIL	28480	0490-0916
A2P1	1251-2293	7	CONNECTOR;1-CONT SKT .032 DIA	00779	60373-2
A2P2	1251-2293		CONNECTOR;1-CONT SKT .032 DIA	00779	60373-2
A2Q1	1854-0404	10	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A2R1	0698-0084	1	RESISTOR 2.15K 1% .125W F TUBULAR	16299	C4-1/8-T0-2151-F
A2R2	0757-1060	1	RESISTOR 196 OHM 1% .5W F TUBULAR	30983	MF7C1/2-T0-196R-F
A2R3	0757-0441	1	RESISTOR 8.25K 1% .125W F TUBULAR	24546	C4-1/8-T0-8251-F
A2R4	0698-3405	1	RESISTOR 422 OHM 1% .5W F TUBULAR	19701	MF7C1/2-T0-422R-F
A2R5	0757-0438	10	RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A2R6	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A2R7	0757-0401	2	RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A2R8	0698-3403	1	RESISTOR 348 OHM 1% .5W F TUBULAR	19701	MF7C1/2-T0-348R-F
A2R9	0757-0276	1	RESISTOR 61.9 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-6192-F
A2VR1	1902-3139	1	DIODE-ZNR 8.25V 5% DO-7 PD=.4W	04713	SZ 10939-158
A2XA3	1251-1626	3	CONNECTOR; PC EDGE; 12-CONT; DIP SOLDER	71785	252-12-30-300
A2XA4	1251-1626		CONNECTOR; PC EDGE; 12-CONT; DIP SOLDER	71785	252-12-30-300
			A2 MISCELLANEOUS		
	0360-1514	14	TERMINAL; SLDR STUD	28480	0360-1514
A3	86602-60001		BOARD ASSY, ALC	28480	86602-60001
A3C1	0180-0058	2	CAPACITOR-FXD; 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A3C2	0180-0058		CAPACITOR-FXD; 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A3C3	0160-2199	2	CAPACITOR-FXD 30PF +-5% 300WVDC MICA	28480	0160-2199
A3C4	0160-2199		CAPACITOR-FXD 30PF +-5% 300WVDC MICA	28480	0160-2199
A3C5	0160-0302	1	CAPACITOR-FXD .018UF +-10% 200WVDC POLYE	56289	292P18392
A3C6	0160-3468	1	CAPACITOR-FXD .12UF +-10% 80WVDC POLYE	56289	292P1249R8
A3C7	0160-2204		CAPACITOR-FXD 100PF +-5% 300WVDC MICA	28480	0160-2204
A3CR1	1901-0047	3	DIODE-SWITCHING 10NS 20V 75MA	28480	1901-0047
A3CR2	1901-0047		DIODE-SWITCHING 10NS 20V 75MA	28480	1901-0047
A3CR3	1901-0047		DIODE-SWITCHING 10NS 20V 75MA	28480	1901-0047
A3CR4	1901-0050	2	DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A3K1	0490-0916		RELAY; REED; 1A .5A 50V CONT; 5V COIL	28480	0490-0916
A3L1	9140-0237	4	COIL; FXD; MOLDED RF CHOKE; 200UH 5%	24226	15/203
A3L2	9140-0237		COIL; FXD; MOLDED RF CHOKE; 200UH 5%	24226	15/203
A3L3	9140-0105	2	COIL; FXD; MOLDED RF CHOKE; 8.2UH 10%	24226	15/821
A3Q1	1853-0020	16	TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A3Q2	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3Q3	1855-0020	1	TRANSISTOR; J-FET N-CHAN, D-MODE SI	28480	1855-0020
A3Q4	1853-0034	5	TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0034
A3Q5	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A3Q6	1853-0034		TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0034
A3Q7	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3Q8	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A3Q9	1853-0034		TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0034
A3Q10	1854-0221	2	TRANSISTOR-BIPOL SI NPN DUAL	28480	1854-0221

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-2.

Table 6-2. *Replaceable Parts*

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3Q11	1854-0053	1	TRANSISTOR NPN 2N2218 SI PD=800MW	04713	2N2218
A3R1	0698-3154	3	RESISTOR 4.22K 1% .125W F TUBULAR	16299	C4-1/8-T0-4221-F
A3R2	0757-0394	3	RESISTOR 51.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-51R1-F
A3R3	0698-0083	14	RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A3R4	2100-2517	3	RESISTOR; VAR; TRMR; 50KOHM 10% C	19701	ET50X503
A3R5	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A3R6	0757-0482	1	RESISTOR 511K 1% .125W F TUBULAR	91637	MFF-1/8,T-1
A3R7	0757-0416	4	RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A3R8	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A3R9	0757-0442	4	RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A3R10	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A3R11	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A3R12	0698-3440	6	RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-196R-F
A3R13	0698-3450	2	RESISTOR 42.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4222-F
A3R14	0757-0399	3	RESISTOR 82.5 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-82R5-F
A3R15	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A3R16	0698-3154		RESISTOR 4.22K 1% .125W F TUBULAR	16299	C4-1/8-T0-4221-F
A3R17	0757-0280	13	RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A3R18	0757-0346	1	RESISTOR 10 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-10R0-F
A3R19	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A3R20	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A3R21	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A3R22	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-196R-F
A3R23	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A3R24	0757-0399		RESISTOR 82.5 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-82R5-F
A3R25	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A3R26	0757-0198	1	RESISTOR 100 OHM 1% .5W F TUBULAR	30983	MF7C1/2-T0-101-F
A3R27	0757-0394		RESISTOR 51.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-51R1-F
A3R28	0757-0394		RESISTOR 51.1 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-51R1-F
A3R29	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A3R30	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A3R31	0757-0465	3	RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A3VR1	1902-3036	1	DIODE-ZNR 3.16V 5% DO-7 PD=.4W TC=	04713	SZ 10939-38
			A3 MISCELLANEOUS		
	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
	4040-0748	2	EXTRACTOR, P.C. BOARD, BLACK	28480	4040-0748
	1480-0073	13	PIN:DRIVE 0.250" LG	00000	OBD
	4040-0749	1	EXTRACTOR-PC BOARD, BROWN	28480	4040-0749
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A4	86602-60003	1	BOARD ASSY, DETECTOR AMPLIFIER	28480	86602-60003
A4C1	0180-0116	2	CAPACITOR-FXD; 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A4C2	0180-0116		CAPACITOR-FXD; 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A4C3	0160-0945	1	CAPACITOR-FXD 910PF +-5% 100WVDC MICA	28480	0160-0945
A4C4	0160-2244	2	CAPACITOR-FXD 3PF +-.25PF 500WVDC CER	28480	0160-2244
A4C5	0180-1743	1	CAPACITOR-FXD; .1UF+-10% 35VDC TA-SOLID	56289	150D104X9035A2
A4C6	0160-2244		CAPACITOR-FXD 3PF +-.25PF 500WVDC CER	28480	0160-2244
A4CR1	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A4K1	0490-0916		RELAY; REED; 1A .5A 50V CONT; 5V COIL	28480	0490-0916
A4L1	9140-0237		COIL; FXD; MOLDED RF CHOKE; 200UH 5%	24226	15/203
A4L2	9140-0237		COIL; FXD; MOLDED RF CHOKE; 200UH 5%	24226	15/203
A4Q1	1853-0034		TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0034
A4Q2	1853-0034		TRANSISTOR PNP SI CHIP TO-18 PD=360MW	28480	1853-0034
A4Q3	1854-0221		TRANSISTOR-BIPOL SI NPN DUAL	28480	1854-0221
A4Q4	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A4Q5	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A4R1 †	0698-3453	5	RESISTOR 196K 1% .125W F TUBULAR	16299	C4-1/8-T0-1963-F
A4R2 †	0698-3453		RESISTOR 196K 1% .125W F TUBULAR	16299	C4-1/8-T0-1963-F
A4R3 †	0757-0465		RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A4R4	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A4R5 †	0698-3453		RESISTOR 196K 1% .125W F TUBULAR	16299	C4-1/8-T0-1963-F
A4R6	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A4R7	0757-0438		RESISTOR 5.11K 1% .125W F TUBULAR	24546	C4-1/8-T0-5111-F
A4R8 †	0757-0465		RESISTOR 100K 1% .125W F TUBULAR	24546	C4-1/8-T0-1003-F
A4R9 †	0698-5844	1	RESISTOR 4.3M 5% .25W CC TUBULAR	01121	CB4355
A4R10	0698-3159	1	RESISTOR 26.1K 1% .125W F TUBULAR	16299	C4-1/8-T0-2612-F
A4R11	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-196R-F
A4R12 †	0698-3453		RESISTOR 196K 1% .125W F TUBULAR	16299	C4-1/8-T0-1963-F
A4R13	2100-2517		RESISTOR; VAR; TRMR; 50KOHM 10% C	19701	ET50X503
A4R14	0757-0399		RESISTOR 82.5 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-82R5-F
A4R15	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-2.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A4R16	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A4R17*	0698-3442	1	RESISTOR 237 OHM 1% .125W F TUBULAR * FACTORY SELECTED PART	16299	C4-1/8-T0-237R-F
A4R18	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A4R19	0698-3447	2	RESISTOR 422 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-422R-F
A4R20	0698-0082	10	RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-4640-F
A4R21	0698-3447		RESISTOR 422 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-422R-F
A4R22	0698-3157	1	RESISTOR 19.6K 1% .125W F TUBULAR	16299	C4-1/8-T0-1962-F
A4R23	0698-3455	1	RESISTOR 261K 1% .125W F TUBULAR	16299	C4-1/8-T0-2613-F
A4R24	0757-0439	2	RESISTOR 6.81K 1% .125W F TUBULAR	24546	C4-1/8-T0-6811-F
A4R25†	0698-0082		RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-4640-F
A4R26†	2100-2489	1	RESISTOR; VAR; TRMR; 5KOHM 10% C	19701	ET50X502
A4S1	3101-0973	1	SWITCH; SL; DPDT NS; .5A 125VAC/DC	79727	GF126-0018
A4TP1	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A4TP2	0360-1514		TERMINAL; SLDR STUD	28480	0360-1514
A4U1	1826-0013	1	IC LIN AMPLIFIER	28480	1826-0013
			A4 MISCELLANEOUS		
	4040-0748		EXTRACTOR, P.C. BOARD, BLACK	28480	4040-0748
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
	4040-0751	1	EXTRACTOR-PC BD ORN LEXAN .062 BD THKNS	28480	4040-0751
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A5	5086-7049	1	MODULATOR, 2.75-3.95 GHZ	28480	5086-7049
A5J1			NSR		
A5J2			NSR		
A5J3			NSR		
A5J4			NSR		
A5J5			NSR		
A5J6			NSR		
A6	5086-7048	1	AMPLIFIER-DETECTOR, 1300 MHZ	28480	5086-7048
A6J1			NSR		
A6J2			NSR		
A6J3			NSR		
A6J4			NSR		
A6J5			NSR		
A6J6			NSR		
A7	86602-60016	1	MIXER ASSY	28480	86602-60016
A7J1	86602-20022	3	CONNECTOR BULKHEAD	28480	86602-20022
A7J2	86602-20022		CONNECTOR BULKHEAD	28480	86602-20022
A7J3	86602-20022		CONNECTOR BULKHEAD	28480	86602-20022
			A7 MISCELLANEOUS		
	0360-0124	3	TERMINAL .040	28480	0360-0124
	5001-0002	1	COVER, FILTER	28480	5001-0002
	86602-00003	1	COVER, MIXER, SMALL	28480	86602-00003
	86602-00004	1	COVER, MIXER, LARGE	28480	86602-00004
	86602-20010	1	BOARD, TRANSITION	28480	86602-20010
	86602-20018	1	HOUSING, MIXER	28480	86602-20018
	86602-20026	1	BUSHING	28480	86602-20026
	86602-20029	1	SUPPRESSOR	28480	86602-20029
A7A1	86602-20009	1	BOARD, MIXER BALUN	28480	86602-20009
A7A2	86602-60008	1	BOARD ASSY, BALANCE MIXER	28480	86602-60008
A7A2CR1	5080-0271	1	DIODE, QUAD	28480	5080-0271
A7A3	5086-7066	1	FILTER, LOW PASS 1.45 GHZ	28480	5086-7066
A8	5086-7071	1	AMPLIFIER, 4 GHZ	28480	5086-7071
A8J1			NSR		
A8J2			NSR		
A9	86602-60011	1	BOARD ASSY, ATTENUATOR DRIVER (EXCEPT OPTION 001)	28480	86602-60011
A9CR1	1901-0025	8	DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR2	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR3	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR4	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR5	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-2.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9CR6	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR7	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR8	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9Q1	1853-0213	4	TRANSISTOR PNP 2N4236 SI CHIP PD=1W	04713	2N4236
A9Q2	1854-0361	4	TRANSISTOR NPN 2N4239 SI PD=800MW	04713	2N4239
A9Q3	1853-0213		TRANSISTOR PNP 2N4236 SI CHIP PD=1W	04713	2N4236
A9Q4	1854-0361		TRANSISTOR NPN 2N4239 SI PD=800MW	04713	2N4239
A9Q5	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A9Q6	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A9Q7	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A9Q8	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A9Q9	1853-0213		TRANSISTOR PNP 2N4236 SI CHIP PD=1W	04713	2N4236
A9Q10	1854-0361		TRANSISTOR NPN 2N4239 SI PD=800MW	04713	2N4239
A9Q11	1853-0213		TRANSISTOR PNP 2N4236 SI CHIP PD=1W	04713	2N4236
A9Q12	1854-0361		TRANSISTOR NPN 2N4239 SI PD=800MW	04713	2N4239
A9Q13	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A9Q14	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A9Q15	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A9Q16	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A9R1	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A9R2	0757-0159	8	RESISTOR 1K 1% .5W F TUBULAR	30983	MF7C1/2-TO-1RO-F
A9R3	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-196R-F
A9R4	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	30983	MF7C1/2-TO-1RO-F
A9R5	0698-0082		RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-4640-F
A9R6	0698-0082		RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-4640-F
A9R7	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A9R8	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	30983	MF7C1/2-TO-1RO-F
A9R9	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-196R-F
A9R10	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	30983	MF7C1/2-TO-1RO-F
A9R11	0698-0082		RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-4640-F
A9R12	0698-0082		RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-4640-F
A9R13	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A9R14	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	30983	MF7C1/2-TO-1RO-F
A9R15	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-196R-F
A9R16	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	30983	MF7C1/2-TO-1RO-F
A9R17	0698-0082		RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-4640-F
A9R18	0698-0082		RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-4640-F
A9R19	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-TO-1001-F
A9R20	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	30983	MF7C1/2-TO-1RO-F
A9R21	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-TO-101-F
A9R22	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	30983	MF7C1/2-TO-1RO-F
A9R23	0698-0082		RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-4640-F
A9R24	0698-0082		RESISTOR 464 OHM 1% .125W F TUBULAR	16299	C4-1/8-TO-4640-F
A9VR1	1902-3002	4	DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=	04713	SZ 10939-2
A9VR2	1902-3002		DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=	04713	SZ 10939-2
A9VR3	1902-3002		DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=	04713	SZ 10939-2
A9VR4	1902-3002		DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=	04713	SZ 10939-2
			A9 MISCELLANEOUS		
	4040-0752	2	EXTRACTOR-PC BOARD, YELLOW	28480	4040-0752
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
	4040-0752		EXTRACTOR-PC BOARD, YELLOW	28480	4040-0752
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A10	86602-60006	1	BOARD ASSY, REFERENCE	28480	86602-60006
A10C1			NOT ASSIGNED		
A10C2	0180-0291	1	CAPACITOR-FXD; 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A10K1	0490-0916		RELAY; REED; 1A .5A 50V CONT; 5V COIL	28480	0490-0916
A10K2	0490-0916		RELAY; REED; 1A .5A 50V CONT; 5V COIL	28480	0490-0916
A10K3	0490-0916		RELAY; REED; 1A .5A 50V CONT; 5V COIL	28480	0490-0916
A10K4	0490-0916		RELAY; REED; 1A .5A 50V CONT; 5V COIL	28480	0490-0916
A10K5	0490-0916		RELAY; REED; 1A .5A 50V CONT; 5V COIL	28480	0490-0916
A10K6	0490-0916		RELAY; REED; 1A .5A 50V CONT; 5V COIL	28480	0490-0916
A10Q1	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A10Q2	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A10Q3	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A10Q4	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A10Q5	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A10Q6	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A10Q7	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A10Q8	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A10Q9	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A10Q10	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10Q11	1855-0082	1	TRANSISTOR; J-FET P-CHAN, D-MODE SI	28480	1855-0082
A10R1	0757-0279	1	RESISTOR 3.16K 1% .125W F TUBULAR	24546	C4-1/8-T0-3161-F
A10R2	2100-2517		RESISTOR; VAR; TRMR; 50KOHM 10% C	19701	ET50X503
A10R3	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A10R4	0757-0817	1	RESISTOR 750 OHM 1% .5W F TUBULAR	30983	MF7C1/2-T0-751-F
A10R5	2100-2633	2	RESISTOR; VAR; TRMR; 1KOHM 10% C	19701	ET50X102
A10R6 †	0757-0443	1	RESISTOR 11K 1% .125W F TUBULAR	24546	C4-1/8-T0-1102-F
A10R7	2100-2633		RESISTOR; VAR; TRMR; 1KOHM 10% C	19701	ET50X102
A10R8	0757-0416		RESISTOR 511 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-511R-F
A10R9	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A10R10	0698-3260	2	RESISTOR 464K 1% .125W F TUBULAR	19701	MF4C1/8-T0-4643-F
A10R11	0698-3260		RESISTOR 464K 1% .125W F TUBULAR	19701	MF4C1/8-T0-4643-F
A10R12	0698-3453		RESISTOR 196K 1% .125W F TUBULAR	16299	C4-1/8-T0-1963-F
A10R13	0757-0439		RESISTOR 6.81K 1% .125W F TUBULAR	24546	C4-1/8-T0-6811-F
A10R14	0683-1065	1	RESISTOR 10M 5% .25W CC TUBULAR	01121	CB1065
A10R15	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A10R16	0698-3450		RESISTOR 42.2K 1% .125W F TUBULAR	16299	C4-1/8-T0-4222-F
A10R17	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A10R18	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A10R19	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A10R20	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A10R21	0698-4406	2	RESISTOR 115 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-115R-F
A10R22	0698-4482	1	RESISTOR 17.4K 1% .125W F TUBULAR	03888	PME55-1/8-T0-1742-F
A10R23	0698-4406		RESISTOR 115 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-115R-F
A10R24	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A10R25	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A10R26	0698-3486	2	RESISTOR 232 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-232R-F
A10R27	0698-3498	1	RESISTOR 8.66K 1% .125W F TUBULAR	16299	C4-1/8-T0-866R-F
A10R28	0698-3486		RESISTOR 232 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-232R-F
A10R29	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A10R30	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A10R31	0698-3510	2	RESISTOR 453 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-453R-F
A10R32	0698-3154		RESISTOR 4.22K 1% .125W F TUBULAR	16299	C4-1/8-T0-4221-F
A10R33	0698-3510		RESISTOR 453 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-453R-F
A10R34	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A10R35	0698-0083		RESISTOR 1.96K 1% .125W F TUBULAR	16299	C4-1/8-T0-1961-F
A10R36	0698-3495	2	RESISTOR 866 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-866R-F
A10R37	0698-4430	1	RESISTOR 1.91K 1% .125W F TUBULAR	16299	C4-1/8-T0-1911-F
A10R38	0698-3495		RESISTOR 866 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-866R-F
A10R39	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A10R40	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A10R41 †	0757-0442		RESISTOR 10K 1% .125W F TUBULAR	24546	C4-1/8-T0-1002-F
A10U1	1826-0081	1	IC LIN LM318H AMPLIFIER	27014	LM318H
A10VR1	1902-0041	1	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=	04713	SZ 10939-98
			A10 MISCELLANEOUS		
	4040-0753	2	EXTRACTOR-PC BOARD, GREEN	28480	4040-0753
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
	4040-0753		EXTRACTOR-PC BOARD, GREEN	28480	4040-0753
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
A11 †	86602-60037	1	BOARD ASSY, LOGIC	28480	86602-60037
A11C1	0180-2206	1	CAPACITOR-FXD; 60UF+-10% 6VDC TA-SOLID	56289	150D606X900682
A11L1	9140-0105		COIL; FXD; MOLDED RF CHOKE; 8.2UH 10%	24226	15/821
A11U1	1820-0508	1	IC DGTL N8202N REGISTER	18324	N8202N
A11U2	1820-0077	1	IC DGTL SN74 74 N FLIP-FLOP	01295	SN7474N
A11U3	1820-0069	1	IC;DGTL;GATE	01295	SN7420N
A11U4	1820-0305	1	IC;DGTL;ADDER	01295	SN7483N
A11U5	1820-0054	4	IC;DGTL;GATE	01295	SN7400N
A11U6	1820-0054		IC;DGTL;GATE	01295	SN7400N
A11U7	1820-0639	1	IC DGTL MC 4001P CONVERTER	04713	MC4001P
A11U8	1820-0174	1	IC DGTL SN74 04 N INVERTER	01295	SN7404N
A11U9	1820-0054		IC;DGTL;GATE	01295	SN7400N
A11U10	1820-0054		IC;DGTL;GATE	01295	SN7400N
			A11 MISCELLANEOUS		
	4040-0754	2	EXTRACTOR-PC BOARD, BLUE	28480	4040-0754
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD
	4040-0754		EXTRACTOR-PC BOARD, BLUE	28480	4040-0754
	1480-0073		PIN:DRIVE 0.250" LG	00000	OBD

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-2.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A12 †	86602-60038	1	BOARD ASSY, LOGIC MOTHER	28480	86602-60038
A12C1	0160-2055	2	CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A12C2	0160-2055		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2055
A12L1	9140-0144	2	COIL; FXD; MOLDED RF CHOKE; 4.7UH 10%	24226	10/471
A12L2	9140-0144		COIL; FXD; MOLDED RF CHOKE; 4.7UH 10%	24226	10/471
A12XA9	1251-1626		CONNECTOR; PC EDGE; 12-CONT; DIP SOLDER	71785	252-12-30-300
A12XA10	1251-2034	1	CONNECTOR; PC EDGE; 10-CONT; DIP SOLDER	71785	252-10-30-300
A12XA11	1251-1388	1	CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	71785	252-15-30-008
A13	86601-60039	1	ATTENUATOR ASSY, 5 SECTION (EXCEPT OPTION 001)	28480	86601-60039
A13J1			NSR		
A13J2			NSR		
A14	86602-60018	1	WIRING HARNESS, MAIN(EXCEPT OPTION 001; INCLUDES P3,P7,P8,P13 & P14)	28480	86602-60018
A14	86602-60019	1	WIRING HARNESS, MAIN(OPTION 001 ONLY; INCLUDES P3,P7,P8,P13 & P14)	28480	86602-60019
A15 †	86602-60035	1	AMPLIFIER ASSY, 20 MHZ	28480	86602-60035
A15C1	0160-2437	7	CAPACITOR-FXD 5000PF +80-20% 200WVDC CER	28480	0160-2437
A15C1			NSR		
A15J1	1250-1194	2	CONNECTOR-COAX; SM SLD; 50 OHM MALE	98291	52-045-4610
A15J1			NSR		
A15J2	1250-1194		CONNECTOR-COAX; SM SLD; 50 OHM MALE	98291	52-045-4610
A15J2			NSR		
			CHASSIS PARTS		
AT1	0960-0084	1	ISOLATOR	28480	0960-0084
AT1J1			NSR		
AT1J2			NSR		
C1	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER	28480	0160-2437
C2	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER (EXCEPT OPTION 001)	28480	0160-2437
C3	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER (EXCEPT OPTION 001)	28480	0160-2437
C4	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER (EXCEPT OPTION 001)	28480	0160-2437
C5	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER (EXCEPT OPTION 001)	28480	0160-2437
C6	0160-2437		CAPACITOR-FXD 5000PF +80-20% 200WVDC CER	28480	0160-2437
C7	0160-2436	1	CAPACITOR-FXD 10PF +-20% 200WVDC CER	28480	0160-2436
C8	0160-3451	1	CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
C9 †	0180-2141	1	CAPACITOR-FXD; 3.3UF+-10% 50VDC TA	56289	150D335X9050B2
FL1	9135-0009	1	FILTER:4 GHZ	28480	9135-0009
FL1J1			NSR		
FL1J2			NSR		
FL1J3			NSR		
FL1J4			NSR		
J1			OUTPUT JACK, TYPE N (P/O A13 ATTENUATOR ASSY, NSR, SEE MP1, EXCEPT OPTION 001)		
J1			OUTPUT JACK, TYPE N (SEE MP2 THRU MP9; OPT 001 ONLY)		
L1	9140-0210	2	COIL; FXD; MOLDED RF CHOKE; 100UH 5%	24226	15/103
L2	9140-0210		COIL; FXD; MOLDED RF CHOKE; 100UH 5%	24226	15/103
M1 †	1120-0543	1	METER, 1MA, WINDOW MOUNT	32171	820723
MP1	08731-210	1	NUT, LOCK (EXCEPT OPT 001; PART OF J1)	28480	08731-210
MP2	2950-0132	1	NUT-HEX-DBL CHAM 7/16-28-THD .094-THK (OPT 001 ONLY;PART OF J1)	73734	76500NP
MP3	1250-0914	1	CONNECTOR-COAX; APC-N; 50 OHM FEMALE (OPT 001 ONLY;PART OF J1)	90949	131-150
MP4	1250-0915	1	CONTACT, RF CONNECTOR, FEMALE CENTER (OPT 001 ONLY;PART OF J1)	71785	131-149
MP5	5040-0306	1	INSULATOR (OPT 001 ONLY;PART OF J1)	28480	5040-0306
MP6	08555-20093	1	CONTACT, JACK (OPT 001 ONLY;PART OF J1)	28480	08555-20093

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-2.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
MP7	08761-2027	1	INSULATOR (OPT 001 ONLY; PART OF J1)	28480	08761-2027
MP8	08555-20094	1	BODY, BULKHEAD (OPT 001 ONLY; PART OF J1)	28480	08555-20094
MP9	2190-0104	1	WASHER-LK INTL T .439 IN D .547 IN D (OPT 001 ONLY; PART OF J1)	78189	1922-04
MP10 †	1251-0546	10	CONTACT:R & P CONNECTOR, RECTANGULAR (P/O W8,W9,W11, & W12; 1 EACH) (P/O W13,W14, & W15; 2 EACH)	81312	III17054S
MP11	1250-1193	3	CONNECTOR-COAX; (P/O W9,10, & 11; 1EA)	98291	52-328-0019
MP12	1250-1221	2	CONNECTOR-COAX; SM SLD; 50 OHM MALE (INCLUDES P1, P2; P/O W1 & W3)	24931	33JS118-1
MP13	1250-1295	1	CONNECTOR-COAX;RT ANGLE 50 OHM(P/O W1)	16179	OSM531-3
MP14	1250-1227	1	CONNECTOR-COAX; SMA; 50 OHM MALE(P/O W3)	28480	1250-1227
P1			NSR, PART OF MP12		
P2			NSR, PART OF MP12		
P3	1251-2293		CONNECTOR;1-CONT SKT .032 DIA (PART OF A14)	00779	60373-2
P4	1251-2293		CONNECTOR;1-CONT SKT .032 DIA (PART OF A14)	00779	60373-2
P5	1251-2293		CONNECTOR;1-CONT SKT .032 DIA (PART OF A14)	00779	60373-2
P6	86602-60020	1	CONNECTOR ASSY (INCLUDES W8,W9,W11,W12, W13,W14,W15).	28480	86602-60020
	5040-0382	1	CONNECTOR BODY	28480	5040-0382
	5040-0383	1	CONNECTOR FACE	28480	5040-0383
	1251-1911	5	CONTACT, RP RECT	81312	100-1016S
	1251-3087	18	CONTACT	81312	100-0908S
P7	1251-2293		CONNECTOR;1-CONT SKT .032 DIA (PART OF A14)	00779	60373-2
P8	1251-2293		CONNECTOR;1-CONT SKT .032 DIA (PART OF A14)	00779	60373-2
P9- P12			NOT ASSIGNED		
P13	1251-2262	1	CONNECTOR,PC(2 X 20)40CONTACT(P/O A14)	71785	251-10-30-400
P14	1251-2500	1	CONNECTOR,PC(2 X 12)24CONTACT(P/O A14)	71785	251-06-30-400
R1	2100-3113	1	RESISTOR-VAR 2.5K 10% CC	01121	WA4G036S252AZ
R2	0698-3430	1	RESISTOR 21.5 OHM 1% .125W F TUBULAR	03888	PME55-1/8-T0-21R5-F
S1	3100-3088	1	SWITCH; RTRY; SGL IDX; STD; SPDT PS	28480	3100-3088
TB1	0360-1780	1	TERMINAL; STRIP; 5-TERM	71002	13558
W1	86602-60024	1	CABLE ASSY, LO INPUT, BLACK (INCLUDES MP12 & MP13)	28480	86602-60024
W2 †	86602-20033	1	CABLE ASSY, 4 GHZ AMPLIFIER OUTPUT	28480	86602-20033
W3	86602-60025	1	CABLE ASSY, RF INPUT, BLACK (INCLUDES MP12 & MP14)	28480	86602-60025
W4	86602-20027	1	CABLE ASSY, ISOLATOR OUTPUT	28480	86602-20027
W5	86602-20025	1	CABLE ASSY,MOD OUTPUT	28480	86602-20025
W6	86602-20023	1	CABLE ASSY, MIXER OUTPUT	28480	86602-20023
W7	86602-20016	1	CABLE ASSY,OUTPUT (OPT 001 ONLY)	28480	86602-20016
W7	86602-20021	1	CABLE ASSY,ATTENUATOR INPUT (EXCEPT OPTION 001)	28480	86602-20021
W8	86602-60012	1	CABLE ASSY,AM INPUT,GRAY/YELLOW (P/O P6; INCLUDES MP10)	28480	86602-60012
W9	86602-60023	1	CABLE ASSY,PULSE INPUT, WHITE/GREEN (P/O P6; INCLUDES MP10 & MP11)	28480	86602-60023
W10 †	86602-20034	1	CABLE, 4 GHZ FILTER OUTPUT	28480	86602-20034
W11 †	86602-60033	1	CABLE ASSY,20 MHZ INPUT, WHITE/BLUE (P/O P6; INCLUDES MP10 & MP11)	28480	86602-60033
W12 †	86602-60034	1	CABLE ASSY,20 MHZ OUTPUT, WHITE/RED (P/O P6; INCLUDES MP10 & MP11)	28480	86602-60034
W13	8120-1128	1	CABLE ASSY,100 MHZ, WHITE/BROWN (P/O P6; INCLUDES MP10)	28480	8120-1128
W14	8120-1126	1	CABLE ASSY,20/30 MHZ, WHITE/ORANGE (P/O P6; INCLUDES MP10)	28480	8120-1126
W15	8120-1129	1	CABLE ASSY,350/450 MHZ, WHITE/YELLOW (P/O P6; INCLUDES MP10)	28480	8120-1129
			MISCELLANEOUS & CABINET PARTS		
	0370-1089	1	KNOB; BASE; RND; .5 IN; JGK; SGI DECAL	28480	0370-1089
	0370-1107	1	KNOB; BASE; PTR AND BAR; .5 IN; JGK; (OPTION 001 ONLY)	28480	0370-1107
	0370-2386	1	KNOB (EXCEPT OPTION 001)	28480	0370-2386

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-2.

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	3050-0029	4	WASHER-FL MTLC .378 IN D .5 IN D (OPTION 001 ONLY)	28480	3050-0029
	3050-0090	1	WASHER; DOME PL PRPHY; DOME PL PRPHY (EXCEPT OPTION 001)	78189	3564-28-01
	86601-00013	1	LATCH	28480	86601-00013
	86601-00014	1	BRACKET,ATTENUATOR (EXCEPT OPTION 001)	28480	86601-00014
	86601-00034	1	PANEL, FRONT (EXCEPT OPTION 001)	28480	86601-00034
	86601-00036	1	MOUNT METER	28480	86601-00036
	86601-00052†	2	COVER, HALF	28480	86601-00052
	86601-20017	1	HOUSING, FRONT	28480	86601-20017
	86601-20018	1	PANEL, REAR	28480	86601-20018
	86601-20019	1	STUD, LATCH	28480	86601-20019
	86601-20020	1	WASHER, LATCH	28480	86601-20020
	86601-20069	1	FRAME, FRONT PANEL	28480	86601-20069
	86601-20080†	2	GUIDE, PLUG-IN	28480	86601-20080
	86601-40018	1	SCREW, ADJUST METER	28480	86601-40018
	86602-00001	1	SUPPORT, RIGHT	28480	86602-00001
	86602-00002	1	SUPPORT, LEFT	28480	86602-00002
	86602-00005	1	SUPPORT, TOP	28480	86602-00005
	86602-00006	1	SUPPORT, BOTTOM	28480	86602-00006
	86602-00007	1	PANEL, FRONT (OPT 001 ONLY)	28480	86602-00007
	86602-00008	1	SUPPORT, FILTER	28480	86602-00008
	86602-20017	1	WINDOW	28480	86602-20017
	86602-20019	2	PLATE, SUPPORT FRONT	28480	86602-20019
	86602-20020	1	PLATE, SUPPORT REAR	28480	86602-20020
	86602-20028	2	GUIDE, CONNECTOR	28480	86602-20028

Table 6-3. Code List of Manufacturers

Mfr Code	Manufacturer Name	Address	Zip Code
00000	U.S.A. COMMON	ANY SUPPLIER OF THE U.S.A.	
00779	AMP INC	HARRISBURG PA	17105
01121	ALLEN BRADLEY CO	MILWAUKEE WI	53212
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75231
03888	PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
16179	OMNI SPECTRA INC	FARMINGTON MI	48024
16299	CORNING GL WK ELEC CMPNT DIV	RALEIGH NC	27604
18324	SIGNETICS CORP	SUNNYVALE CA	94086
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
24226	GOWANDA ELECTRONICS CORP	GOWANDA NY	14070
24546	CORNING GLASS WORKS	BRADFORD PA	16701
24931	SPECIALTY CONNECTOR CO INC	INDIANAPOLIS IN	46227
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
30983	MEPCO/ELECTRA CORP	SAN DIEGO CA	92121
32171	MODUTEC INC	NORWALK CT	06854
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
71002	BIRNBACK CO INC	FREEPORT LI NY	11520
71785	TRW ELEK COMPONENTS CINCH DIV	ELK GROVE VILLAGE IL	60007
73734	FEDERAL SCREW PRODUCTS CO	CHICAGO IL	60618
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF	ELGIN IL	60126
79727	C-W INDUSTRIES	WARMINSTER PA	18974
81312	WINCHESTER ELEK DIV LITTON IND INC	OAKVILLE CT	06779
9D949	AMPHENOL SALES DIV OF BUNKER-RAMO	HAZELWOOD MO	63042
91637	DALE ELECTRONICS INC	COLUMBUS NE	68601
98291	SEALECTRO CORP	MAMARONECK NY	10544

See introduction to this section for ordering information

† FOR BACKDATING, SEE TABLE 7-2.

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section contains information for adapting this manual to instruments for which the content does not apply directly. In addition, information about recommended modifications for improvements to the instrument is provided.

7-3. MANUAL CHANGES

7-4. To adapt this manual to your instrument, refer to Table 7-1 and make all of the manual changes listed opposite your instrument serial number. Perform these changes in the sequence listed.

7-5. If your instrument serial number is not listed on the title page of this manual or in Table 7-1 below, it may be documented in a yellow MANUAL CHANGES supplement. For additional important information about serial number coverage refer to INSTRUMENTS COVERED BY MANUAL in Section I.

Table 7-1. Manual Changes by Serial Number

Serial Prefix or Number	Make Manual Changes
1216A00101 thru 1216A00130	J thru D, B, A
1216A00131, 132, and 140	J thru H and F thru A
1216A00133 thru 137, 141 thru 145, 147, and 150	J thru A
1239A	J thru B
1240A00138, 139, 146, and 149	J thru C
1240A00151 thru 164, 166, 168 and 170	J thru D
1241A00165, 167, 169 and 171 thru 190	J thru E
1243A00191 thru 193, 195 thru 197, 199, 203, 204, and 207 thru 210	J thru F
1243A00194, 198, 200 thru 202, 205, and 206	J thru H, F
1245A	J, I, H
1248A	J, I
1305A	J

7-6. MANUAL CHANGE INSTRUCTIONS

Change A

Table 6-2 and Service Sheet 3:

Change A4R1, R2, R3, and R8 to HP Part No. 0757-0458, RESISTOR FIXED 51.1K OHMS 1/8W, 24546, C4-1/8-TO-5112-F.

Change A4R5 and R12 to HP Part No. 0757-0465, RESISTOR FIXED 100K OHMS 1% 1/8W, 24546, C4-1/8-TO-1003-F.

MANUAL CHANGES

Change A (Cont'd)

Table 6-2 and Service Sheet 3 (Cont'd):

Delete A1C1 and A1L3. (On schematic, show direct connection from white-blue-violet wire to A1P5).

Table 6-2 and Service Sheet 4:

Change A10R6 to 0757-0199, RESISTOR FIXED 21.5K OHMS 1% 1/8W, 24546, C4-1/8-TO-5621-F.

Delete A10R41. (On schematic, show direct connection from A10R6 to A1R4.)

Table 6-2:

Change W2 to HP Part No. 08660-20024. Change W10 to HP Part No. 08660-20030.

Change B

Table 6-2 and Service Sheet 2:

Delete A15, W11, and W12.

Change C

Table 6-2 and Service Sheet 2:

For instruments with serial number suffixes from 00131 to 00151; if FL1 is to be replaced, order the new FL1 (9135-0009), W2 (86602-20044) and W10 (86602-20034). Refer to paragraph 7-9.

Change D

Table 6-2 and Service Sheet 3:

It is recommended that A4C6 be added to instruments prefixed 1240A and below. See paragraph 7-13.

Change E

Table 6-2 and Service Sheet 3:

Change A4R9 to HP Part No. 0698-5844, RESISTOR 4.3M OHM 5% 0.25W, 01121, CB4355.

Change F

Table 6-2:

Change MP10 to HP Part No. 1251-2040.

NOTE

On instruments with serial prefixes 1243A and below, if the RF sockets in P6 push out when the plug-in section is installed, order the new retainer clips, HP Part No. 1251-3044, and Service Note 86602A-2 for complete installation instructions.

MANUAL CHANGES

Change G

Table 6-2, and Service Sheet 3:
Delete C9 on TB1.

Change H

Table 6-2 and Service Sheet 3:
Change M1 to 1120-1564 METER, 28480, 1120-1564.
Change A4R25 to 0757-0461 RESISTOR, 68.1K OHM 1% 1/8W, 24546, C4-1/8-TO-6812-F.
Change A4R26 to 2100-2517 RESISTOR, VAR 50K OHM 10%, 19701, ET 50X503.

NOTE

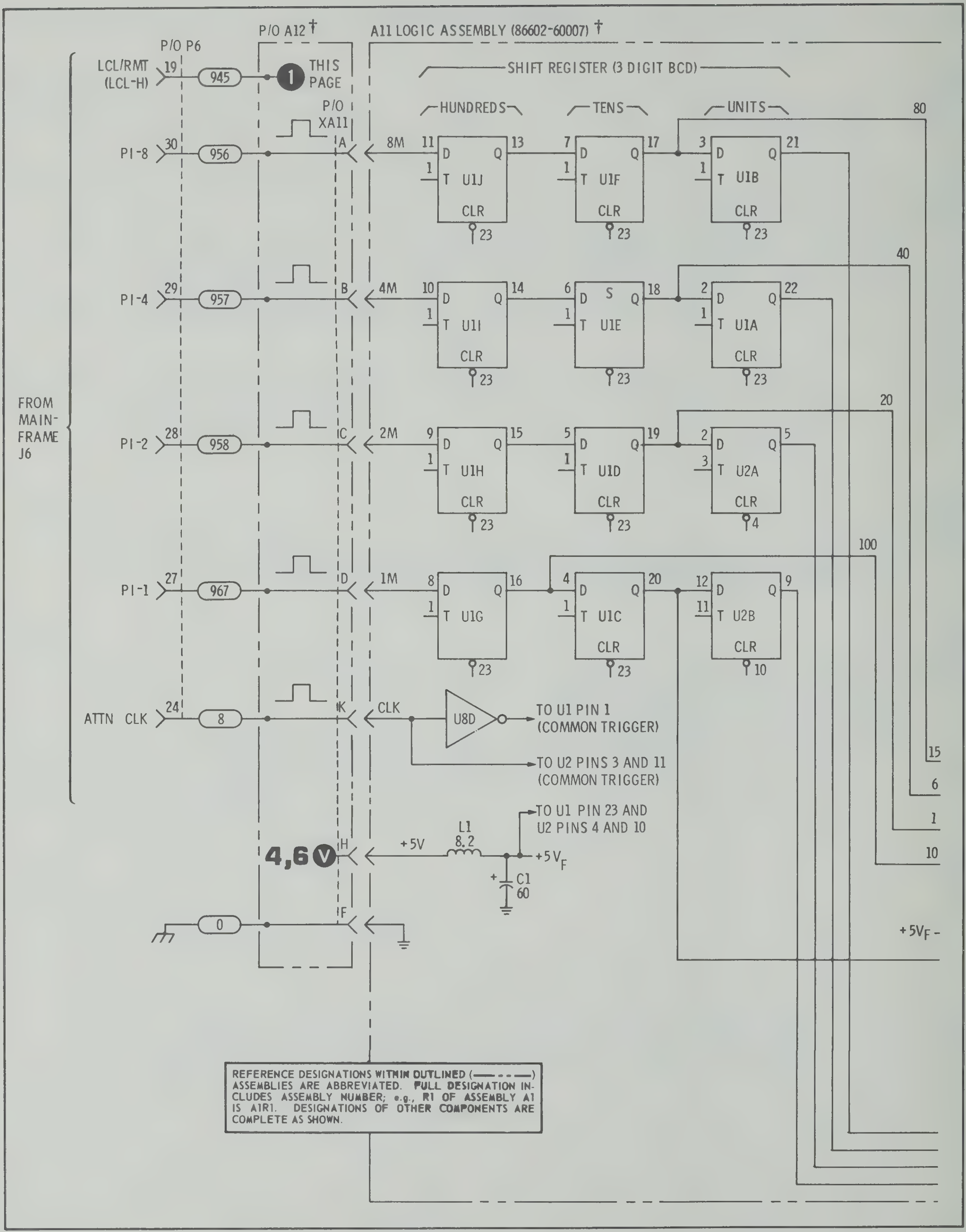
If trouble is encountered in meter M1 on instruments with serial prefixes 1245A00270 and below, Hewlett-Packard recommends replacing the old meter with the new meter listed in this manual by ordering replacement kit 86602-60036.

Change I

Table 6-2:
Delete HP Part No. 86601-00052 and 86601-20080.
Add HP Part No. 86601-00029 COVER, OUTER, 28480, 86601-00029.

Change J

Table 6-2 and Service Sheet 5:
Change A11 to HP Part No. 86602-60007.
Change A12 to HP Part No. 86602-60004.
Refer to paragraph 7-19 and follow the instructions for improving RF shielding. Use Figure 7-1 partial schematic in place of the corresponding portion of the schematic on Service Sheet 5.



REFERENCE DESIGNATIONS WITHIN OUTLINED (—— - - ——) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER; e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.

Figure 7-1. Partial Schematic of Logic Assembly Schematic Diagram (part of Change J)

INSTRUMENT MODIFICATIONS

7-7. INSTRUMENT IMPROVEMENT MODIFICATIONS

7-8. Hewlett-Packard has developed certain recommended instrument modifications that can be used to improve the performance and reliability of earlier verions of the instrument. In some cases, replacing certain parts requires a modification to make these instruments compatible with parts now in use (if the original part is no longer available). These modifications are outlined in the following procedures and are keyed to instruments by serial number or serial number prefix.

7-9. Replacing FL1 (Serials 1216A00131 thru 150)

7-10. On instruments prefixed 1216A00132 thru 150, if FL1 must be replaced, use the new FL 1 (HP Part No. 9135-0009) and the following new parts:

W2 HP Part No. 86602-20033
W10 HP Part No. 86602-20034

7-11. Improved Amplitude Modulation Performance

7-12. For instruments with serial prefixes 1239A and below, to improve the AM modulation low frequency response and distortion at 10 MHz and below, the following parts are required:

Qty	Description	HP Part No.
4	196K Ohm Resistor	0698-3453
2	100K Ohm Resistor	0757-0465
1	11K Ohm Resistor	0757-0443
1	10K Ohm Resistor	0757-0442

Order Service Note 86602A-4 for complete instructions.

7-13. Elimination of Oscillation in A4

7-14. The ALC Detector Amplifier (A4) Assembly in instruments prefixed 1240A and below will sometimes oscillate at maximum vernier settings. To preclude this possibility, Hewlett-Packard recommends adding a 3 pF capacitor, HP Part No. 0160-2244, in parallel with A4R12, a 196 KΩ resistor.

7-15. Prevention of RF Sockets from Pushing Out of P6

7-16. On instruments with serial prefixes 1243A and below, if the RF sockets in P6 push out when the plug-in section in installed, order the new retainer clips (HP Part No. 1251-3044) and Service Note 86602A-2 for complete installation instructions.

7-17. Recommended Meter Replacement

7-18. If trouble is encountered in meter M1 on instruments with serial prefixes 1245A00270 and below, Hewlett-Packard recommends replacing the old meter with the new meter listed in this manual by ordering replacement kit 86602-60036. Additional parts necessary for mounting the new meter and instructions are included in the kit.

7-19. Improving RF Shielding

7-20. For instruments with serial prefixes 1305A-00430 and below, to reduce RF leakage, a washer, HP Part No. 3050-0090, may be added behind the RF Output connector nut on the front panel. This improves the grounding of the connector body. Remove the RF connector and install the new washer behind it. Make sure the nut is tightened firmly against the front panel.

Table 7-2. Summary of Changes by Component (1 of 2)

Change	A1	A2	A3	A4	A5	A6	A7	A8
A	C1 L1			R1 R2 R3 R5 R8 R12				
B								
C								
D				C6*				
E				R9				
F								
G								
H								
I								
J	Change Assembly							

*Instrument modification recommended, see paragraph 7-7.

Table 7-2. Summary of Changes by Component (2 of 2)

Change	A9	A10	A11	A12	A13	A14	A1	A15	No Prefix
A		R6 R41							W2 W10
B								Delete Assembly	P2 P4 W11 W12
C									FL1 W2 W10
D									
E									
F									MP10*
G									C9
H									M1*
I									Outer Cover
J				Change Assembly. Use partial schematic.					

*Instrument modification recommended, see paragraph 7-7.

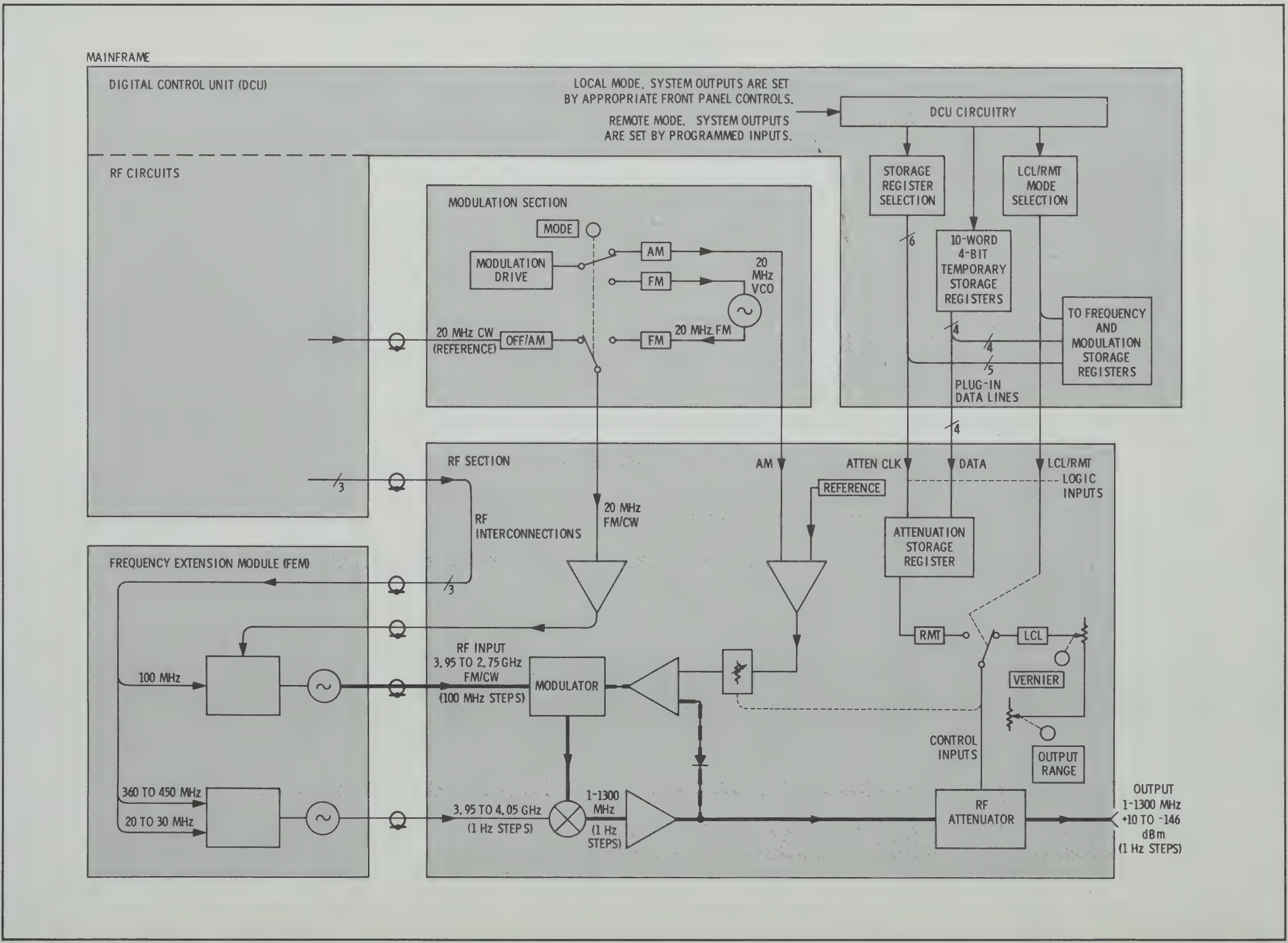

MAINFRAME
DIGITAL CONTROL UNIT (DCU)
LOCAL MODE. SYSTEM OUTPUTS ARE SET BY APPROPRIATE FRONT PANEL CONTROLS.
REMOTE MODE. SYSTEM OUTPUTS ARE SET BY PROGRAMMED INPUTS.
DCU CIRCUITRY
STORAGE REGISTER SELECTION
LCL/RMT MODE SELECTION
10-WORD 4-BIT TEMPORARY STORAGE REGISTERS
TO FREQUENCY AND MODULATION STORAGE REGISTERS
6
4
4
5
PLUG-IN DATA LINES
4
RF CIRCUITS
MODULATION SECTION
MODE
MODULATION DRIVE
AM
FM
20 MHz VCO
20 MHz CW (REFERENCE)
OFF/AM
FM
20 MHz FM
3
RF SECTION
RF INTERCONNECTIONS
3
20 MHz FM/CW
AM
ATTEN CLK
DATA
LCL/RMT
LOGIC INPUTS
REFERENCE
ATTENUATION STORAGE REGISTER
RMT
LCL
VERNIER
OUTPUT RANGE
CONTROL INPUTS
RF ATTENUATOR
FREQUENCY EXTENSION MODULE (FEM)
100 MHz
360 TO 450 MHz
20 TO 30 MHz
RF INPUT 3.95 TO 2.75 GHz FM/CW (100 MHz STEPS)
MODULATOR
3.95 TO 4.05 GHz (1 Hz STEPS)
1-1300 MHz (1 Hz STEPS)
OUTPUT 1-1300 MHz +10 TO -146 dBm (1 Hz STEPS)

Figure 8-1. RF Section System Operation

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section contains troubleshooting and repair information for the HP Model 86602A RF Section plug-in. Safety of technical personnel is considered. Circuit operation and troubleshooting on system, RF Section-to-section or assembly, and stage or component levels is provided. Also troubleshooting aids are considered.

8-3. Preceeding the service sheets is information which relates to the RF Section plug-in as part of the 8660-series Synthesized Signal Generator System.

8-4. The service sheets normally include principles of operation and troubleshooting information, a component location diagram, and a schematic, all of which apply to a specific portion of circuitry within the instrument.

8-5. Service Sheet 1 includes an overview of the instrument operation, troubleshooting on an assembly or stage level, and a troubleshooting block diagram. The block diagram also serves as an "index" for the other service sheets.

8-6. The Schematic Diagram Notes, Figure 8-2, aid in interpreting the schematics.

8-7. The last foldout in the manual includes a table which cross-references all pictorial and schematic locations of each assembly, chassis mounted component, and adjustable component. The figure is a pictorial representation of the RF Section and shows location of the aforementioned parts.

8-8. SAFETY CONSIDERATIONS

8-9. Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in safe condition (see Sections II, III, and V). Service and adjustments should be performed only by qualified service personnel.

8-10. Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

8-11. Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

WARNING

The service information is often used with power supplied and protective covers removed from the instrument. Energy available at many points may, if contacted, result in personal injury.

8-12. PRINCIPLES OF OPERATION

8-13. The Principles of System Operation explains how the RF Section operates within the Synthesized Signal Generator System, i.e., how other sections affect the RF Section and in turn how they are affected by the RF Section. Control functions in both local and remote modes are also explained.

8-14. A block diagram which shows system operation with the emphasis on the RF Section plug-in is found in Figure 8-1.

8-15. Overall operation of the RF Section is discussed in Service Sheet 1. The following service sheets are concerned only with sections and/or circuit assemblies within the RF Section plug-in.

8-16. TROUBLESHOOTING

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (System Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, refer to the (Note continued)

NOTE (Cont'd)

> *Systems Troubleshooting information which preceeds Service Sheet 1. This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, return to Service Sheet 1 for further troubleshooting information.*

8-17. System Troubleshooting

8-18. The System Troubleshooting information in Section VIII of the HP 8660-series mainframe manual should be used when first attempting to isolate a circuit defect. If the defect could be caused by more than an individual instrument in the system, the technician is normally directed to the System Troubleshooting in the RF Section manual. The problem may then be isolated to the RF Section, Modulation Section, Frequency Extension Module, or the mainframe.

8-19. RF Section Troubleshooting

8-20. When the defect has been isolated to the RF Section, refer to Service Sheet 1. This information is used to isolate the problem to a section or assembly.

8-21. Troubleshooting Aids

8-22. Circuit Board Aids. Test points are physically located on the circuit boards as metal posts or circuit pads and usually have either a reference designator (such as TP1) or a label which relates to the function (AM, Pulse, ID, etc.). Transistor emitters, diode cathodes, the positive lead of electrolytic capacitors, and pin 1 of integrated circuits are indicated by a variety of symbols such as E, a diode symbol, +, and a tear-drop shape respectively. Also, a square circuit pad (as opposed to the round pad) may be used in place of any of the previously mentioned symbols.

8-23. Service Sheet Aids. RF levels, ac voltages, and dc voltages are often shown on schematic diagrams. Integrated circuit connection diagrams plus diagrams of relays and printed circuit connectors help to locate specific inputs and outputs. Notes are used to explain certain circuits or mechanical configurations not easily shown on the schematic.

8-24. The locations of individual components mounted on printed circuit boards are found on individual service sheets on the pictorial representation of the circuit boards. Chassis mounted parts, major assemblies, and adjustable components locations are found on the last foldout in this manual.

8-25. Table 8-2, Schematic Diagram Notes, provides information relative to symbols and values shown on the schematic diagrams.

8-26. Service Kit and Extender Boards. The HP 11672A Service Kit contains interconnect cables, RF cables, various coaxial adaptors, and an adjustment tool, all of which are useful in servicing the RF Section plug-ins. Refer to the HP 11672A Operating Note for a listing and pictorial representation of the contents.

8-27. Circuit board extenders are provided with the mainframe. These extender boards enable the technician to extend plug-in boards clear of the assembly to provide easy access to components and test points.

8-28. RECOMMENDED TEST EQUIPMENT

8-29. Table 1-2 lists the test equipment and accessories recommended for use in servicing the instrument. If any of the recommended test equipment is unavailable, instruments with equivalent specifications may be used.

8-30. REPAIR

8-31. Non-Repairable Assemblies

8-32. Repairs should not be attempted on the following assemblies if any is found to be defective during troubleshooting:

A5	2.75 - 3.95 GHz Modulator Assembly
A6	1 - 1300 MHz Amplifier/Detector Assembly
A8	4.0 GHz Amplifier Assembly
A13	10 dB Step Attenuator Assembly
A15	20 MHz Amplifier

8-33. Module Exchange Program

8-34. The A13 Attenuator Assembly may be replaced by ordering a replacement assembly on the Module Exchange Program. Refer to Section VI for ordering information.

8-35. Removal and Disassembly Procedures

8-36. The procedures for removing the RF Section plug-in from the mainframe, removing the covers, and front panel disassembly are found on the left hand foldout page which faces the last foldout in the manual.

8-37. The machine screws used throughout the plug-in have a Pozidriv head. Pozidriv is very similar in appearance to the Phillips head, but using a Phillips screwdriver may damage the Pozidriv screw head.

8-38. RF SECTION OPERATION IN THE SYSTEM

8-39. In order to understand the operation of the RF Section or to effectively troubleshoot it, the entire Synthesizer Signal Generator System must be understood. The emphasis here is on the RF Section and its relationship with the other units which make up the system.

8-40. Principles of System Operation

8-41. The HP Model 86602A RF Section plug-in (as part of the HP 8660-series Synthesized Signal Generator System) has an RF Output of +10 to −146 dBm across 50Ω from 1 to 1299.999 999 MHz. The RF signals coupled from mainframe to the Frequency Extension Module are converted to two phase-locked frequency-stepped outputs which are coupled to the RF Section. The signals are mixed, amplified, and coupled to the OUTPUT jack through the RF Attenuator.

8-42. The RF detector produces a dc output proportional to the RF output signal. The dc output is compared to a reference voltage. Any difference in dc levels produces an error current which drives the PIN diode modulator. The current flow through the PIN diodes controls the RF output level. Therefore, the negative feedback loop described, is an ALC loop which holds the RF output level constant.

8-43. Output Frequency Selection. The desired output frequency is selected by the Digital Control Unit (DCU) in the mainframe. Control logic levels to the mainframe RF circuits set the frequencies of the signals to the Frequency Extension Module. Other logic levels are coupled to the extension module from the mainframe to set the frequency of the generated RF outputs which are coupled to RF Section. The signals are mixed and the converted signal is coupled to the OUTPUT jack.

8-44. Modulation Selection. The amplitude modulation drive signal is coupled to the RF Section from the Modulation Section. The drive signal is superimposed on the reference level which controls the ALC loop. Thus, the ALC loop causes the RF output level to change at the modulation signal rate.

8-45. Frequency modulation is accomplished by setting the Modulation Mode control to FM. The modulation drive signal frequency modulates a 20 MHz VCO signal which is generated in the Modulation Section. This signal is coupled to the RF Section, amplified, and coupled on to the Frequency Extension Module. The extension module circuits extract the frequency modulation information from the 20 MHz signal and use it to frequency modulate the 2.75 to 3.95 GHz oscillator signal. This signal is then coupled to the RF Section circuits.

8-46. RF Output Level Selection. The RF output level is selected by the front panel OUTPUT RANGE switch and the VERNIER control. The VERNIER control (in conjunction with the front panel meter) is used to set the output within a usable range of 10 dB. The OUTPUT RANGE switch controls the output level range by inserting attenuation in 10 dB steps to 150 dB.

8-47. Remote Operation. In remote mode the frequency, modulation, and RF output levels are programmed into the DCU. Through parallel BCD PI (plug-in) control lines, an input is sent to the various storage registers. A one-of-six address selects the register which will accept the information. Frequency information is routed into one of 3 registers: center frequency, step (except 8660A), and sweep (except 8660A). Modulation information is routed to either the Modulation Mode/Source register or the Modulation Level register. RF output level (attenuation) information is routed to the attenuation storage register in the RF Section by addressing the ATTN CLK. The information is stored until new data is received. Until that time the stored information is connected through various logic and decoding circuits and applied to the relays and switches which set the RF output level to the desired value. The RF Section front panel controls are inoperative in the remote mode.

8-48. System Troubleshooting

8-49. When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe

Operating and Service Manual to begin troubleshooting (System Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, return to System Troubleshooting in this manual and perform the following tests which may help isolate the problem to an instrument (mainframe or a plug-in).

8-50. Preparing the RF Section for Troubleshooting. Follow the Removal and Disassembly Procedures on the foldout page which just preceeds the last foldout in the manual. Follow the directions for removing the RF Section from mainframe, removing its covers, and making the interconnections from mainframe to RF Section for troubleshooting purposes.

8-51. Output Level Incorrect. The following steps check the signal levels input to the RF Section from the Freuqency Extension Module. Also, the attenuation data input to the RF Section must be checked if the instrument is being operated in the remote mode.

a. Disconnect the RF cable connected to P2 (on rear panel above the multi-pin connector P6). Measure the level of the 2.75 to 3.95 GHz signal from the cable with a spectrum analyzer (>+10 dBm). Reconnect the cable to P2.

b. Disconnect the RF cable connected to P1 (on rear panel below the multi-pin connector). Measure the level of the 3.95 to 4.05 GHz signal from the cable with a spectrum analyzer (>−4 dBm). Reconnect the cable to P1.

c. If either signal level from the extension module is incorrect, the problem is either in the extension module or the interconnections to the RF Section. Check the continuity of the cables and, if necessary, refer to the extension module manual for further troubleshooting information.

d. If both signal levels are correct and the system is being operated in the remote mode, switch to local (front panel) control. If the problem is still evident, refer to Service Sheet 1 for further troubleshooting information.

e. If the problem disappears, check continuity of the input data lines (PI-1, PI-2, PI-4, and PI-8) and the ATTN CLK input to the mainframe. If continuity exists, proceed to Section VIII of the mainframe manual for troubleshooting the DCU. Otherwise, refer to Service Sheet 1.

8-52. Frequency Problems. The mainframe center frequency readout is correct but the RF Section Output frequency is incorrect. Only the mainframe and extension module have controlled frequency sections. If the RF frequencies to the extension module are incorrect or the levels too low, the defective circuit is in the mainframe or the interconnections from the mainframe through the RF Section (including the 20 MHz amplifier) to the extension module.

NOTE

If coaxial test cable 11672-60008 (BNC-to-coaxial connector in multi-pin connector J6) is not available, proceed to Step b.

a. Check the low RF inputs to the RF Section. Set the mainframe Line switch to standby (STBY), disconnect the interconnect cable from the multi-pin connector P6 on the RF Section rear panel. Return the mainframe line switch to the ON position. Check the frequencies and levels according to the listing of Tables 8-1, 8-2, and 8-3, with a Spectrum Analyzer and a frequency counter.

b. If any of the levels and frequencies of Step a are incorrect or cable 11672-60008 was not available to check the J6 outputs, check the levels at their assembly outputs in the mainframe. Refer to the Section VIII of the mainframe manual. Check the 20 MHz FM/CW signal at A4J7, 100 MHz at A4J8, and 350 to 450 MHz at A4J12. The 20 to 30 MHz signal is found on the A2 Mother Board Assembly which is located directly beneath the A4 Assembly. Tables 8-1, 8-2, and 8-3 still apply for these measurements. If levels and frequencies of step a are all correct, the same signals must be checked to ensure continuity into the Frequency Extension Module. Refer to the Troubleshooting Information in the extension module manual.

c. If any of the outputs from the mainframe assemblies (step b) are incorrect, refer to the appropriate troubleshooting information relating to the circuits which generate that particular frequency in Section VIII of the mainframe manual. If all inputs (step b) are correct and if any of the J6 outputs (step a) were incorrect. Check continuity of the interconnections to the RF Section. In the case of problems with the 20 MHz CW/FM signal, refer to the Modulation Section manual. If all inputs (step b) are correct and the J6 outputs to the RF Section were not checked, proceed to the extension module for further troubleshooting information.

NOTE

If the problem is not in the RF Section or interconnections, the information in the Frequency Extension Module will determine if the problem is in the digit 8, 9, and 10 logic control inputs from the mainframe or the frequency controlled circuits in the extension module.

Table 8-1. RF Signal Levels

Pin Numbers J6 (Mainframe) or Interconnect Cable	Frequency* (MHz)	Signal Level (dBm)
62	20 MHz ± 1 Hz	>−7 dBm
63	20 to 30 MHz ± 1 Hz	>−7 dBm
64	350 to 450 MHz ± 1 Hz	>+10 dBm
65	100 MHz ± 1 Hz	>+10 dBm

*To achieve the ± 1 Hz tolerance, the System mainframe and the frequency counter must share a common timebase.

8-53. Amplitude Modulation Incorrect. The following steps will determine if the problem is in the RF Section, or the Modulation or Auxiliary Section.

a. Measure the voltage input to the RF Section on the test point labeled AM (located on A12 circuit board assembly on right side rear of plug-in; through cutout slot on the aluminum deck). A modulation level of 100% is achieved with a 1 Vrms input.

b. If the input is low or not present, check continuity of interconnections to the Modulation Section plug-in. If necessary, refer to the troubleshooting information in Section VIII of the Modulation Section manual.

Table 8-2. Center Frequency Versus Frequency of 350 to 450 MHz Signal

Center Frequency Readout	Actual Frequency (350 to 450 MHz Signal)
0.00 GHz	450 MHz
0.01	440
0.02	430
0.03	420
0.04	410
0.05	400
0.06	390
0.07	380
0.08	370
0.09	360
0.10	350*

*450 MHz if 86602A is connected or installed.

c. If the correct drive signal is present, refer to Service Sheet 1 for more troubleshooting information.

8-54. Frequency Modulation Output Defective. If frequency modulation is not present or if the RF Output signal is incorrect in the FM mode, refer to the troubleshooting information in Section VIII of the Modulation Section manual.

8-55. Pulse Modulation problems. Pulse Modulation is normally done using the HP Model 86631B Auxiliary Section and an external pulse generator.

a. Set the Auxiliary Sections External Modulation control to Pulse. Couple an external pulse to the input jack of −10 Vpk with "pulse off" voltage set to 0 Vdc.

b. Measure the voltage on the test point labeled PULSE (located on a circuit board at the right side rear of the plug-in; through the cutout slot on the aluminum deck). This voltage should be about +5 Vdc. Also, check the pulse input from the white-green cable where it enters the A2

Assembly (refer to the last foldout for its location). If either the signal or dc voltage is not present, check continuity back to the Auxiliary Section. If necessary, refer to the HP Model 86631B Operating Note and troubleshoot the Auxiliary Section. Otherwise, refer to Service Sheet 1 for more troubleshooting information.

Table 8-3. Center Frequency Versus Frequency of 20 to 30 MHz Signal

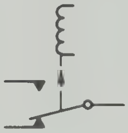
Center Frequency Readout (MHz)	Exact Frequency (20 to 30 MHz Signal) (MHz)	Center Frequency Readout (MHz)	Exact Frequency (20 to 30 MHz Signal) (MHz)	Center Frequency Readout (MHz)	Exact Frequency (20 to 30 MHz Signal) (MHz)
0.000000	30.000000	0.000400	29.999600	0.080000	29.920000
0.000001	29.999999	0.000500	29.999500	0.090000	29.910000
0.000002	29.999998	0.000600	29.999400	0.100000	29.900000
0.000003	29.999997	0.000700	29.999300	0.200000	29.800000
0.000004	29.999996	0.000800	29.999200	0.300000	29.700000
0.000005	29.999995	0.000900	29.999100	0.400000	29.600000
0.000006	29.999994	0.001000	29.999000	0.500000	29.500000
0.000007	29.999993	0.002000	29.998000	0.600000	29.400000
0.000008	29.999992	0.003000	29.997000	0.700000	29.300000
0.000009	29.999991	0.004000	29.996000	0.800000	29.200000
0.000010	29.999990	0.005000	29.995000	0.900000	29.100000
0.000020	29.999980	0.006000	29.994000	1.000000	29.000000
0.000030	29.999970	0.007000	29.993000	2.000000	28.000000
0.000040	29.999960	0.008000	19.992000	3.000000	27.000000
0.000050	29.999950	0.009000	29.991000	4.000000	26.000000
0.000060	29.999940	0.010000	29.990000	5.000000	25.000000
0.000070	29.999930	0.020000	29.980000	6.000000	24.000000
0.000080	29.999920	0.030000	29.970000	7.000000	23.000000
0.000090	29.999910	0.040000	29.960000	8.000000	22.000000
0.000100	29.999900	0.050000	29.950000	9.000000	21.000000
0.000200	29.999800	0.060000	29.940000	9.999999	20.000001
0.000300	29.999700	0.070000	29.930000		

SCHEMATIC DIAGRAM NOTES

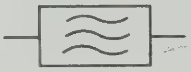
	Resistance in ohms, capacitance in microfarads, inductance in microhenries other otherwise noted.
*	Asterisk denotes a factory-selected value. Value shown is typical. Part may be omitted.
†	Indicates backdating. Refer to Table 7-2.
⊘	Tool-aided adjustment.
○	Manual control.
▭	Encloses front-panel designation.
⬚	Encloses rear-panel designation.
—— - - ——	Circuit assembly borderline.
– – – – – –	Other assembly borderline. Also used to indicate mechanical interconnection (ganging).
━━►━━	Heavy line with arrows indicates path and direction of main signal.
━ ━►━ ━	Heavy dashed line with arrows indicates path and direction of main feedback.
CW	Wiper moves toward CW with clockwise rotation of control (as viewed from shaft or knob).
①	Numbered Test point. Measurement aid provided.
Ⓐ	Lettered Test point. No measurement aid provided.
⬭	Encloses wire color code. Code used is the same as the resistor color code. First number identifies the base color, second number identifies the wider strip, third number identifies the narrower stripe. E.g., 947 denotes white base, yellow wide stripe, violet narrow stripe.
⏚	A direct conducting connection to the earth, or a conducting connection to a structure that has a similar function (e.g., the frame of an air, sea, or land vehicle).
⊥	A conducting connection to a chassis or frame.
▽	Common connections. All like-designated points are connected.

Figure 8-2. Schematic Diagram Notes (1 of 3)

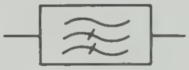
SCHEMATIC DIAGRAM NOTES



Arrows on relays indicate direction of arm movement when energized.



Filters. Specific type indicated by crosses on curved lines.



Example of Highpass Filter.

SWITCH DESIGNATIONS

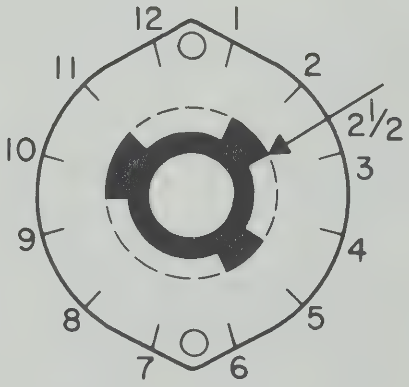
EXAMPLE: A3S1AR(2-1/2)

A3S1 = SWITCH S1 WITHIN ASSEMBLY A3

A = 1ST WAFER FROM FRONT (A=1ST, ETC)

R = REAR OF WAFER (F=FRONT)

(2-1/2) = TERMINAL LOCATION (2-1/2) (VIEWED FROM FRONT)



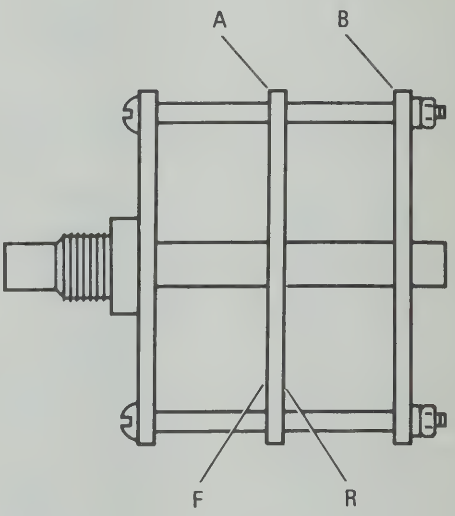


Figure 8-2. Schematic Diagram Notes (2 of 3)

Test point symbols. Stars are numbered or lettered for easy correlation of schematic diagrams, procedures, and locator illustrations.

Arrow connecting star to measurement point signifies no measuring aid provided.

Star shown electrically connected to circuit signifies measuring aid (metal post, circuit pad, etc.) provided.

Interconnection information.

Circled letter indicates circuit path continues on another schematic diagram. Look for same circled letter on service sheet indicated by adjacent bold number (3, in this example).

Assembly part number

Assembly name

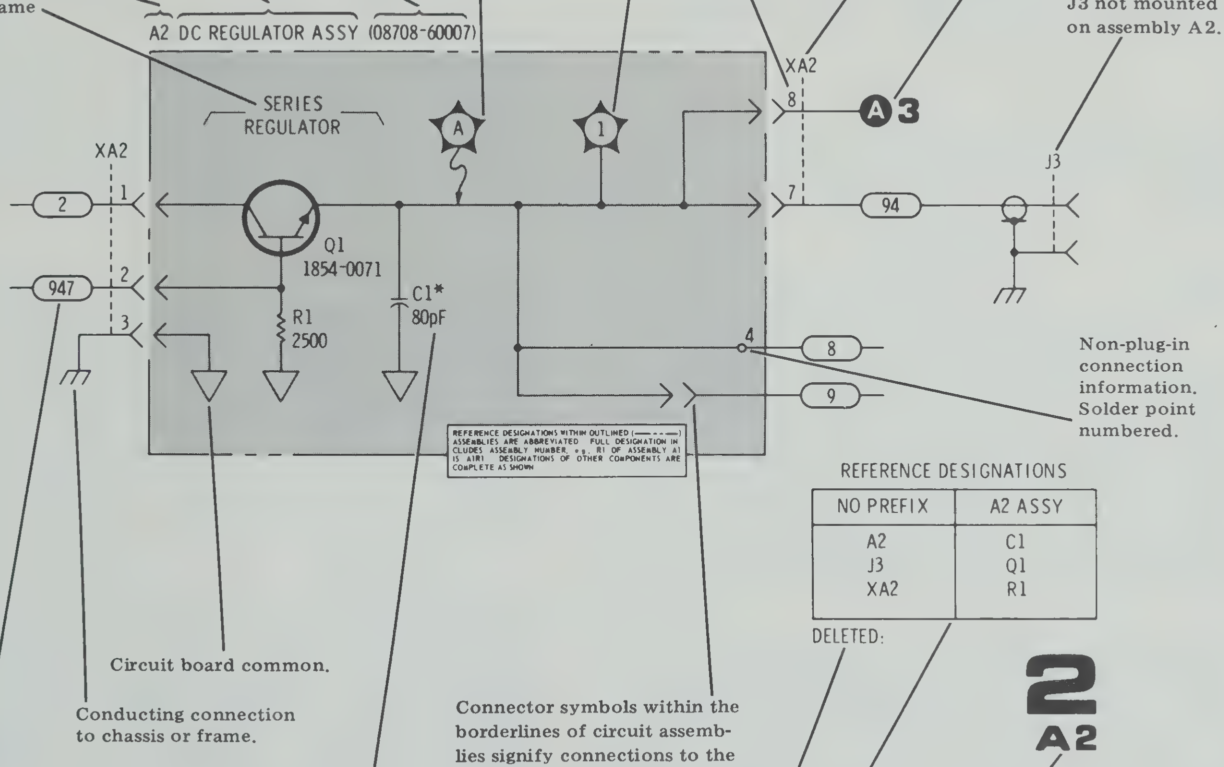
Assembly designation

Stage name

Plug-in connection information. Socket designation for A2 assembly.

Number indicates pin of socket (XA2).

J3 not mounted on assembly A2.


A2 DC REGULATOR ASSY (08708-60007)
SERIES REGULATOR
A
1
XA2
8
A 3
XA2
1
2
3
2
947
Q1
1854-0071
R1
2500
C1*
80pF
7
94
J3
4
8
9
REFERENCE DESIGNATIONS WITHIN OUTLINED (——---——) ASSEMBLIES ARE ABBREVIATED FULL DESIGNATION INCLUDES ASSEMBLY NUMBER, e.g., R1 OF ASSEMBLY A1 IS A1R1 DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN
REFERENCE DESIGNATIONS
NO PREFIX
A2 ASSY
A2
J3
XA2
C1
Q1
R1
DELETED:
2
A2

Non-plug-in connection information. Solder point numbered.

Circuit board common.

Conducting connection to chassis or frame.

Value selected for best operation. Value shown is average or most commonly selected value.

Connector symbols within the borderlines of circuit assemblies signify connections to the assembly which are separate from those made through the integral plug part of the assembly.

Assembly reference designator(s).

Large numbers in lower right corners of schematic diagrams are service sheet numbers. They are provided for convenience in tracing interconnections.

Wire color code. Code used (MIL-STD-681) is the same as the resistor color code. First number identifies the base color, second number the wider stripe, and the third number the narrower stripe. Example, (947) denotes white base, yellow wide stripe, violet narrow stripe.

Reference designators deleted by circuit changes are listed here.

List of all the reference designations on the diagram.

Figure 8-2. Schematic Diagram Notes (3 of 3)

SERVICE SHEET 1

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (System Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, refer to the System Troubleshooting information which preceeds Service Sheet 1 in this manual. This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, return to Service Sheet 1 for further troubleshooting information.

RF SECTION PLUG-IN

PRINCIPLES OF OPERATION

General

A narrowband LO signal is mixed with the RF signal; the difference freuqency is amplified and coupled to the RF Section OUTPUT jack. The RF output voltage level is sampled, compared to a stable reference, and the error is used to control the level of the RF signal as it is passed through the Modulator assembly. Thus the ALC loop maintains the output level relatively constant across the system's specified output range.

The RF output level may be either locally controlled (front panel operation) or remotely controlled (programmed input). In either case, the information is coupled into the Logic Section, the information is converted to drive the 10 dB and/or 1 dB Step Attenuators.

Power Supply and RF interconnections and a 20 MHz amplifier are contained in the RF Section. They supply the power and RF signals which are used to operate the Frequency Extension Module.

Mixer Section

The LO signal is amplified, filtered, and coupled to the Mixer Assembly. The RF Signal passes through an Isolator (20 dB reverse isolation) to the Modulator Assembly.

The modulator presents a variable series attenuation to the RF signal. The series attenuation is controlled by the bias signal from the feedback loop. The bias signal is dependent on the RF output which is compared to a dc reference voltage. Because the front panel RF output is directly proportional to the RF signal level from the Modulator Assembly, and the modulator output is dependent on the Modulator Bias Signal, this feedback loop is, in reality, an automatic level control loop.

Amplifier/Detector Section

The RF Signal from the mixer is amplified 41 dB and coupled to the RF OUTPUT through the 10 dB Step Attenuator.

The RF Detector produces a dc output proportional to the peak RF output. This signal is amplified to drive the front panel meter and the AM Gain compensation circuits in the A10 Assembly.

ALC Section

Reference Assembly. In Local Mode, the RF OUTPUT level is controlled from the front panel controls. A dc reference level varies with change in VERNIER control setting. When the modulation mode is set to AM, the modulation drive signal is superimposed on the dc level output of the reference amplifier. The RF output then follows this combined signal.

In the remote mode, the entire system responds to programmed inputs; the front panel controls of all instruments are inhibited. In the RF Section, the reference output is coupled to the ALC Assembly through the 1 dB Step Attenuator. Therefore, the vernier function is controlled by the 1 dB Step Attenuator.

ALC Amplifier. The ALC Amplifier compares the Detector/Amplifier Assembly output to the Reference Assembly Output. Any change in RF output level or reference level is immediately reflected at the ALC assembly output.

Pulse Modulation Circuits. During Pulse Modulation, the ALC loop is opened at the ALC Amplifier output. With no signal input, a positive bias voltage to the A5 Modulation Assembly causes the RF signal output to be at least 40 dB down from the "on-condition". A −10 Vdc pulse biases the RF "on".

SERVICE SHEET 1 (Cont'd)

Logic Section

Local operation of the 10 dB Step Attenuator is controlled by a logic high on the LCL/RMT input. Thus, control of the 10-dB Step Attenuator by the inputs from the front panel OUTPUT RANGE switch is enabled while the remote inputs are inhibited.

In Remote mode, a logic low on the LCL/RNT input inhibits front panel control and enables data information flow from the mainframe to the Logic Assembly. The ATTN CLK controls the actual data input on the PI-1, PI-2, PI-4, and PI-8 lines to the Logic Assembly. The OUTPUTS to 10-dB Step Attenuator (10L, 20L, 40L, 80L), the over-range (10H), and the 1-dB Step Attenuator outputs (1A, 2A, 4A, 8A) are all controlled by external programming in the Remote Mode. A safety feature, the RESET input, sets the 10-dB Step Attenuator to the maximum attenuation when the Remote mode of operation is first initiated.

Attenuation Section

The Attenuator Section operates identically in local and remote modes. The inputs from the Logic Section (10L, 20L, 40L, and 80L) are used to switch the Attenuator Driver outputs which supply the higher currents needed to switch the 10 dB Step Attenuator sections.

TROUBLESHOOTING

It is assumed that a problem has been isolated to the RF Section as a result of using the System Troubleshooting Guide found in Section VIII of the HP Model 8660-series mainframe Operating and Service Manual and the information in the paragraph entitled System Troubleshooting just preceeding Service Sheet 1 in this manual. Troubleshoot the RF Section using the test equipment, information, and procedures which follow.

Test Equipment

Spectrum Analyzer	HP 8555A/8552B/140T
Oscilloscope	HP 180C/1801A/1821A
Digital Voltmeter	HP 34740A/34702A

Test 1. It is good practice to first check the power supply inputs to the RF Section and at the same time, it may help to check AM, Pulse ID or any other inputs which relate to the problem. The inputs may be checked at the A12 Assembly test points on the right-side rear of this plug-in.

Test 2. If the problem is related to incorrect output level, proceed to Test 3. If it is a unique type problem such as amplitude modulation, noise, etc., refer to the following items for additional troubleshooting hints.

a. **Frequency Problems.** Normally not caused by RF Section. Refer to the paragraph entitled System Troubleshooting in Section VIII of this manual.

b. **Spurious Signals.** May be isolated by checking for signal at various locations in the RF Section. Setting the A4S1 switch to Test may help to isolate the problem to the RF circuitry or ALC loop.

c. **Noise.** Generally noise, which is not generated in the mainframe RF circuits or reference oscillator, originates in Frequency Extension Module or the A15 20 MHz Amplifier Assembly.

d. **Amplitude Modulation.** Verify that the AM signal reaches the A10 Reference Assembly.

If amplitude modulation level changes with an RF level change, check the RF Section front panel meter reading versus measured RF OUTPUT level. If the panel meter reading is correct, refer to Service Sheet 4 (AM Gain input and related circuits). Otherwise, check the meter driver amplifier and related components shown on Service Sheet 3.

Distortion problems may be caused by defective components associated with the Code 1 input (refer to Service Sheets 3 and 4).

If the amplitude modulation level differs from the level shown, see if related adjustments in Section V solves the problem.

NOTE

Be sure the fault isn't in the Modulation Section. An input of 1.0 Vrms to the A10 Reference Assembly should equal 100% AM level.

e. **Pulse Modulation.** Problems may be isolated by checking Pulse In and Pulse ID inputs. Also, check continuity from A5 Modulator Assembly inputs from Auxiliary Section.

SERVICE SHEET 1 (Cont'd)

f. **Incorrect Front Panel Meter Reading.** If ALC loop is operating correctly refer to Service Sheet 3. Otherwise proceed to Test 3.

Test 3. If the RF output level is incorrect by more than 1 or 2 dB, proceed to Test 4. Otherwise, check the 10H input to the A10 Assembly and the related components. If necessary, refer to Section V and perform the adjustments related to RF output level.

Test 4. Proceed to Test 5 if the RF output level is higher than normal. The RF outputs listed in each step of this test (4) are lower than normal. The voltage reading shown in parenthesis is the Modulator Bias Signal and indicates that the ALC loop is holding the RF output low, is trying to increase the RF output, or that a quiescent level, although incorrect, has been reached. Refer to the block diagram for the normal range of Modulator Bias Signal levels.

a. Low RF output but the ALC loop is trying to increase the level (⩾—3 Vdc). Check the RF output of the A7 Mixer Assembly to isolate the defect to either the Service Sheet 2 or 3 assemblies or cables.

b. Low RF output; ALC loop is holding the level low (⩾+10 Vdc). First, check the A10 Reference Assembly output with the VERNIER control set to the CW and CCW positions. If the output is abnormal, refer to troubleshooting information on Service Sheet 4. A normal output indicates the defect is either on the A3 ALC Assembly, A6 Amplifier/Detector Assembly, or A4 Detector Amplifier Assembly. Set the A4S1 switch to the Test position. If the Modulator Bias Signal exhibits the same response as shown in the following table, refer to Service Sheet 3. Otherwise, Service Sheet 4 contains the necessary troubleshooting information.

Modulator Bias Signal

A4S1 Switch	Vernier Control Settings			
	CW		CCW	
	904	907	904	907
Normal	+0.5 Vdc	+0.6 Vdc	+9 Vdc	+1.7 Vdc
Test	—3.7 Vdc	—3.0 Vdc	+0.4 Vdc	+0.6 Vdc

c. The Modulator Bias Signal is at a quiescent level but lower (more positive) than normal. Check the A10 Reference Assembly output level. If the output is lower (more positive than normal), check the 1A, 2A, 4A, and 8A inputs to the A10 Assembly (remote mode only). If they are correct or the instrument is in local mode, refer to Service Sheet 4. If the remote inputs are incorrect or the problem is associated with the 10 dB Step Attenuator, refer to troubleshooting information on Service Sheet 5. Otherwise, refer to troubleshooting information on Service Sheet 3.

Test 5. The RF outputs listed in each step of this test are higher than normal. The voltage reading shown in parenthesis is the Modulator Bias Signal and indicates that the ALC loop is holding the RF output high, is trying to decrease the output level, or that a quiescent level, although incorrect, has been reached. Refer to the block diagram for normal values of Modulator Bias Signal.

a. High RF output; ALC is trying to increase the level (⩾—3 Vdc). Check the A10 Reference Assembly output. If the response to VERNIER control settings is abnormal, refer to Service Sheet 4 and troubleshoot the A10 Assembly. If the response is normal, set the A4S1 switch to test. If the Modulator Bias Signal responds to the VERNIER control settings as indicated by the table of Test 4b, refer to Service Sheet 3 troubleshooting. Otherwise, turn to Service Sheet 4 and continue troubleshooting.

b. High RF output; ALC is trying to decrease the level (⩾+10 Vdc). The A5 Modulator Assembly or associated circuitry is probably defective (refer to Service Sheet 2).

c. The Modulator Bias Signal is at a quiescent level but higher (more negative) than normal. Check the A10 Reference Assembly output. If the A10 output is more negative than normal, check the 1A, 2A, 4A, and 8A inputs to the A10 assembly (remote mode only). If they are correct or the instrument is in local mode, refer to Service Sheet 4. If the remote inputs are incorrect or the problem is associated with the 10 dB Step Attenuator, refer to the troubleshooting information on Service Sheet 5. Otherwise, refer to Service Sheet 3 for troubleshooting.

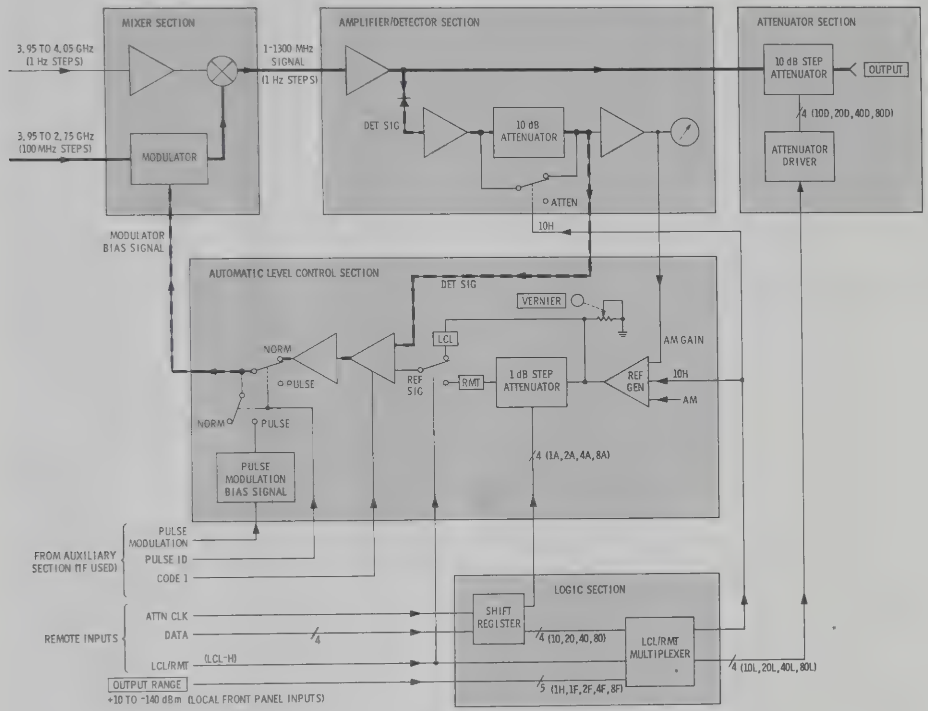
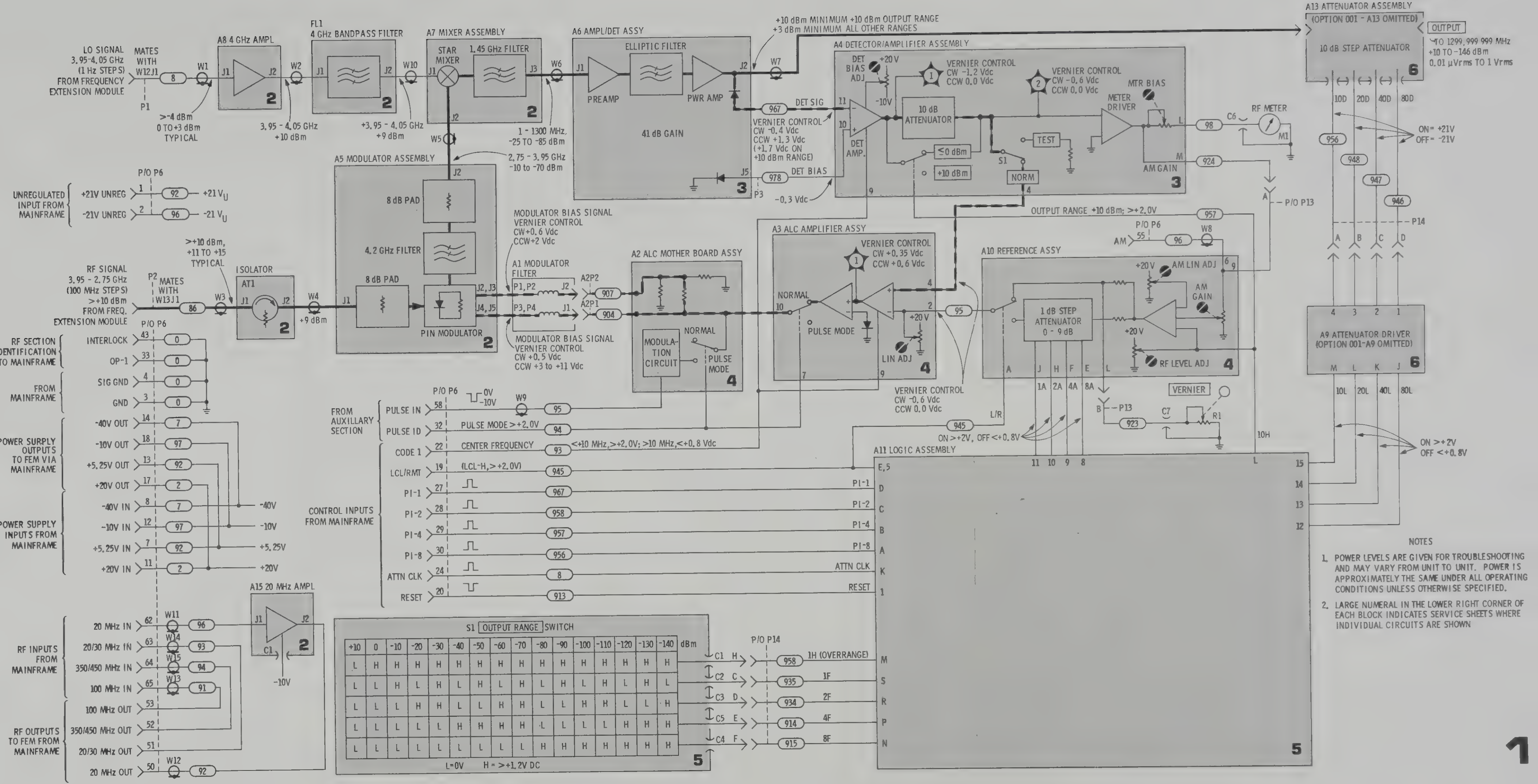


Figure 8-3. Simplified Block Diagram



S1 OUTPUT RANGE SWITCH

+10	0	-10	-20	-30	-40	-50	-60	-70	-80	-90	-100	-110	-120	-130	-140 dBm
L	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
L	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L
L	L	L	H	H	L	L	H	H	L	L	H	H	L	L	H
L	L	L	L	L	H	H	H	H	L	L	L	L	H	H	H
L	L	L	L	L	L	L	L	L	H	H	H	H	H	H	H

L=0V H = >+1.2V DC

C1 H
C2 C
C3 D
C5 E
C4 F

NOTES

1. POWER LEVELS ARE GIVEN FOR TROUBLESHOOTING AND MAY VARY FROM UNIT TO UNIT. POWER IS APPROXIMATELY THE SAME UNDER ALL OPERATING CONDITIONS UNLESS OTHERWISE SPECIFIED.
2. LARGE NUMERAL IN THE LOWER RIGHT CORNER OF EACH BLOCK INDICATES SERVICE SHEETS WHERE INDIVIDUAL CIRCUITS ARE SHOWN

Figure 8-4. Troubleshooting Block Diagram

SERVICE SHEET 2

NOTE

When a malfunction occurs, refer to Section VIII of the HP Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (System Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, refer to the Systems Troubleshooting information which preceeds Service Sheet 1. This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, refer to Service Sheet 1 for further troubleshooting information.

MIXER SECTION

PRINCIPLES OF OPERATION

GENERAL

The LO signal is amplified to drive the mixer and filtered to eliminate unwanted spurious signals. The RF signal is leveled and may be modulated by a bias signal from an ALC loop which is coupled to the A5 Modulator Assembly. After passing through the Modulator, the RF Signal and the LO Signal are mixed and filtered to produce a low level RF output signal.

4 GHz Amplifier/Bandpass Filter

The 3.95 to 4.05 GHz signal is amplified to a high level (+13 dBm) in order to drive the mixer. Unwanted sidebands are eliminated by passing the signal through a bandpass filter before coupling the signal to the Mixer Assembly.

Isolator

The 2.75 to 3.95 GHz RF Signal is passed through the Isolator to the Modulator Assembly. Reverse signal attenuation is about 20 dB.

Modulator Assembly

The effect of the PIN diode Modulator on the RF Signal is that of a variable attenuator. The level of attenuation and therefore the modulator RF output is dependent on the Modulator Bias Signal dc level.

◀ Troubleshooting Block Diagram
SERVICE SHEET 1

SERVICE SHEET 2 (Cont'd)

The PIN Diode Modulator has dynamic attenuation range of >50 dB. A more positive modulator bias signal turns off the series diodes while the shunt diodes are forward biased. The shunt diodes and the series resistor form a voltage divider which attenuates the RF Signal. As the bias voltage goes more negative, the impedance of the shunt diodes increase while the series diodes impedance decreases. Therefore, the RF signal attenuation decreases. The shunt diodes effectively control the attenuation from 12 to >50 dB down while the series diodes are effective only to about 12 dB down.

The RF output level at the front panel jack is directly proportional to the Modulator Assembly RF output. The Modulator Bias Signal controls the A5 Modulator Assembly output and is dependent on an error voltage derived from comparing the RF detector output to the reference dc level.

Mixer Assembly

The RF Signal is passed through a lowpass filter and attenuator before leaving the Modulator Assembly. Then the RF output is mixed with the LO signal in the Mixer Assembly, the mixer output passes through a low pass filter, and the difference frequency is a 1-1300 MHz phase-locked signal with frequency resolution of 1 Hz.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate a circuit defect to the assemblies or cables shown on the accompanying diagram. Troubleshoot the Mixer Section by using the test equipment and procedures given below.

Test Equipment

Spectrum Analyzer .	HP 8555A/8552B/140T
Power Meter	HP 435A/8481A
Digital Voltmeter . . .	HP 34740A/34702A
Service Kit	HP 11672A

Test 1. Check the power supply inputs to the A8 Assembly (+20V and —10V). If correct, proceed to Test 2. Otherwise check for continuity of interconnections to mainframe or an A8 Assembly defect.

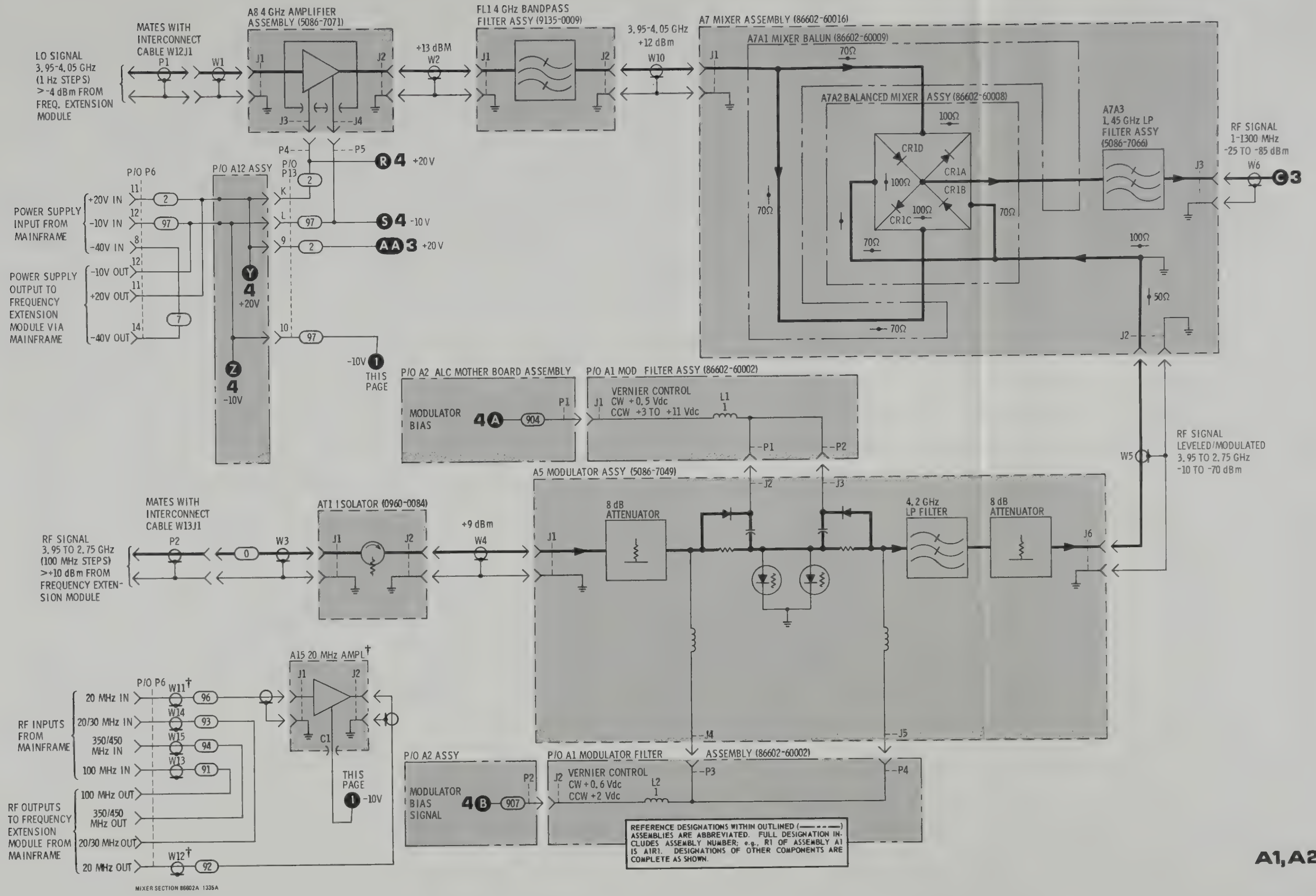
CAUTION

Slight but repeated bending of semi-rigid coaxial cables will damage them very quickly. Bend the cables as little as possible. If necessary, loosen the assembly to release the cable.

Test 2. If the RF power output is greater than normal (refer to the schematic), the A5 Modulator Assembly is probably defective. If the power output is less than normal, checking the difference assembly outputs will quickly isolate the defective assembly or cable.

NOTE

Defects in the A15 20 MHz Amplifier Assembly and RF interconnections from mainframe to Frequency Extension Module (through the RF Section) normally will be isolated by using the Systems troubleshooting which preceeds Service Sheet 1.

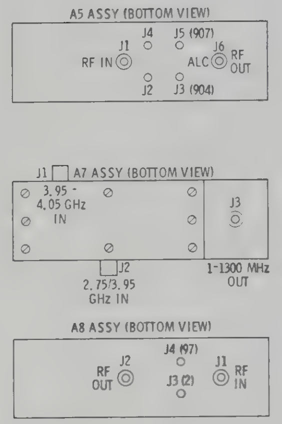


REFERENCE DESIGNATIONS WITHIN OUTLINED (——-·-——) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER; e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.

NOTES

1. SEE FIGURE 8-2 FOR GENERAL NOTES AND SYMBOLS.

† SEE BACKDATING TABLE 7-2.



REFERENCE DESIGNATORS

NO PREFIX	A5 ASSY
AT1J1,2 FL1 J1-4 P1,2, 4-6 W1-6, 10-15	J1-6
	A7 ASSY
	J1-3 A1-3 A2CR1
A1 ASSY	A8 ASSY
J1,2 L1,2 P1-4	J1,2
	A15
A2 ASSY	C1 J1,2
P1,2	

2

A1,A2,A5,A7,A8,A15,AT1,FL1

Figure 8-5. Mixer Section Schematic Diagram

SERVICE SHEET 3

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660-series mainframe Operating and Service Manual to begin troubleshooting (Systems Troubleshooting Guide). Then, if that information indicates possible problems in the RF Section, refer to the Systems troubleshooting information which preceeds Service Sheet 1 in this manual. This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in refer to Service Sheet 1 for further troubleshooting information.

PRINCIPLES OF OPERATION

Amplifier/Detector Assembly

The A6 Amplifier/Detector Assembly contains an RF Preamplifier and Amplifier which are separated by an Elliptic Lowpass Filter. The combined RF gain is 41 dB.

The RF Detector provides a dc output which is proportional to the peak RF output from the A6 Assembly. The dc level charges the 68 pF capacitor which is coupled to the A3 Detector Amplifier Assembly.

DETECTOR AMPLIFIER ASSEMBLY

A small bias current through the RF and Reference diodes is set by A4R13 Detector Bias Adjustment for maximum detector sensitivity. Beyond the initial bias current, any further change in current flow is due to temperature variations. Because the two diodes are located in the same thermal environment, an increase in current flow through the RF Detector diode is matched by an equal increase in current flow through the Reference Diode. The reference diode current is coupled to the non-inverting input of the Detector Amplifier (a discrete operational amplifier comprised of A4Q3, A4Q2, A4Q1 and associated components) while the RF Detector diode output is coupled to the inverting output. Therefore, any change in current flow due to a change in temperature is cancelled in the operational amplifier which leaves the output level dependent only on the peak RF output from the A6 Assembly.

A1 Modulator Filter Assembly
A2 ALC Mother Board Assembly
A5 Modulator Assembly
A7 Mixer Assembly
A8 4 GHz Amplifier Assembly
A15 20 MHz Amplifier Assembly

◆ SERVICE SHEET 2

SERVICE SHEET 3 (Cont'd)

At center frequencies of <10 MHz, the Code 1 input causes A4Q4 to be biased on which connects A4C3 in parallel with the 68 pF capacitor found in the Amplifier/Detector Assembly. As the center frequency is decreased, the detector output needs to be retained for a longer period of time so the leveling circuits responds to the average RF level rather than the instantaneous level.

In output ranges of ≤0 dBm, the Detector Amplifier is coupled directly to the A3 ALC Amplifier Assembly. The output is compared to a dc reference level and an error signal results which is coupled to the A5 Modulator Assembly to complete the ALC loop. When OUTPUT RANGE switch is set to +10 dBm, the 10H logic input goes high (≈+5 Vdc) and turns A4Q5 off. Relay A4K1 opens and the dc voltage is attenuated by 10 dB by A4R19, A4R20, A4R21, and resistors on the A3 assembly. The RF output signal increases by 10 dB which brings the dc output to the A3 ALC Amplifier input back to the quiescent level present before switching to the +10 dBm range.

Amplifier A4U1 functions as an active lowpass filter because of A4R23 and A4C5 which are connected in the feedback loop. The amplifier drives the meter and provides a compensating dc level which varies the AM drive input to keep the amplifier modulation level constant with change in RF output level (VERNIER Control setting).

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate a circuit defect to the assemblies shown on the accompanying diagram. Troubleshooting the Amplifier/Detector and Detector Amplifier Assemblies by using the test equipment and procedures given below.

Test Equipment

Spectrum Analyzer .	HP 8555A/8552B/140T
Digital Voltmeter . . .	HP 34740A/34702A

Test 1. If the circuit problem is associated with the meter and AM Gain output rather than the RF Output level, proceed to Test 2. Check the Detector Output, Detector Amplifier Output A4TP1, and output to ALC Amplifier to see if they are tracking the RF output level. Set A4S1 to the test position. If the RF Amplifier output remains low, the A6 assembly or an associated cable is probably defective. If the RF output increases, measure the detector and A4TP1 and A4TP2 voltages. If the detector output doesn't respond properly, the A6 assembly or an associated component on the A4 assembly, is probably defective. If the detector output increases but the A4TP1 voltage doesn't go more negative, the detector amplifier or an associated component is probably defective.

If the RF output level *is incorrect* only in the +10 dBm range *or is correct* only in the +10 dBm range, and the 10H input is correct for all ranges, the 10 dB attenuator, the relay (A4K1), or an associated component is probably defective.

Test 2. Monitor the RF output with a Spectrum Analyzer. If the modulation level changes with respect to the RF carrier amplitude (change the VERNIER control to three or four different settings), A4U1 or associated components are probably defective. Otherwise, the meter control is misadjusted or the the meter connections or an associated component is probably defective.

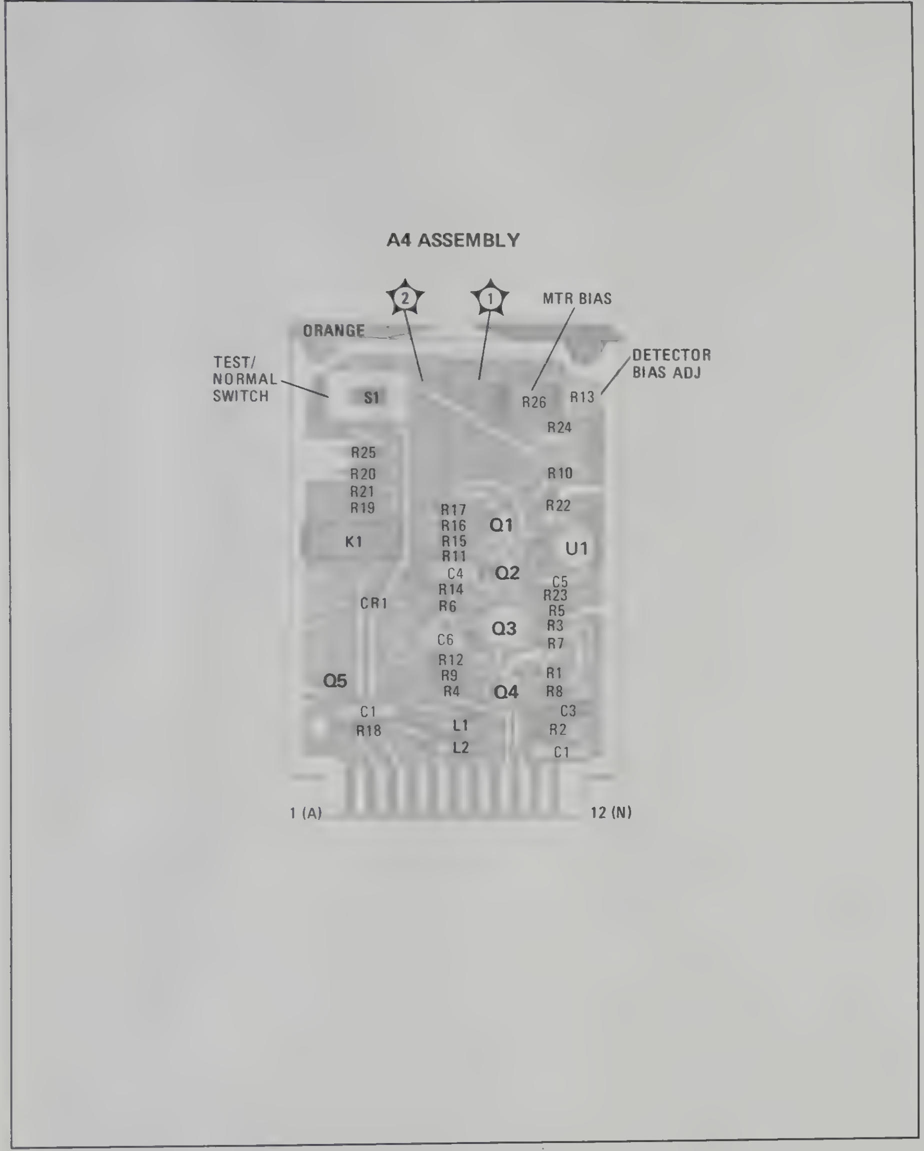
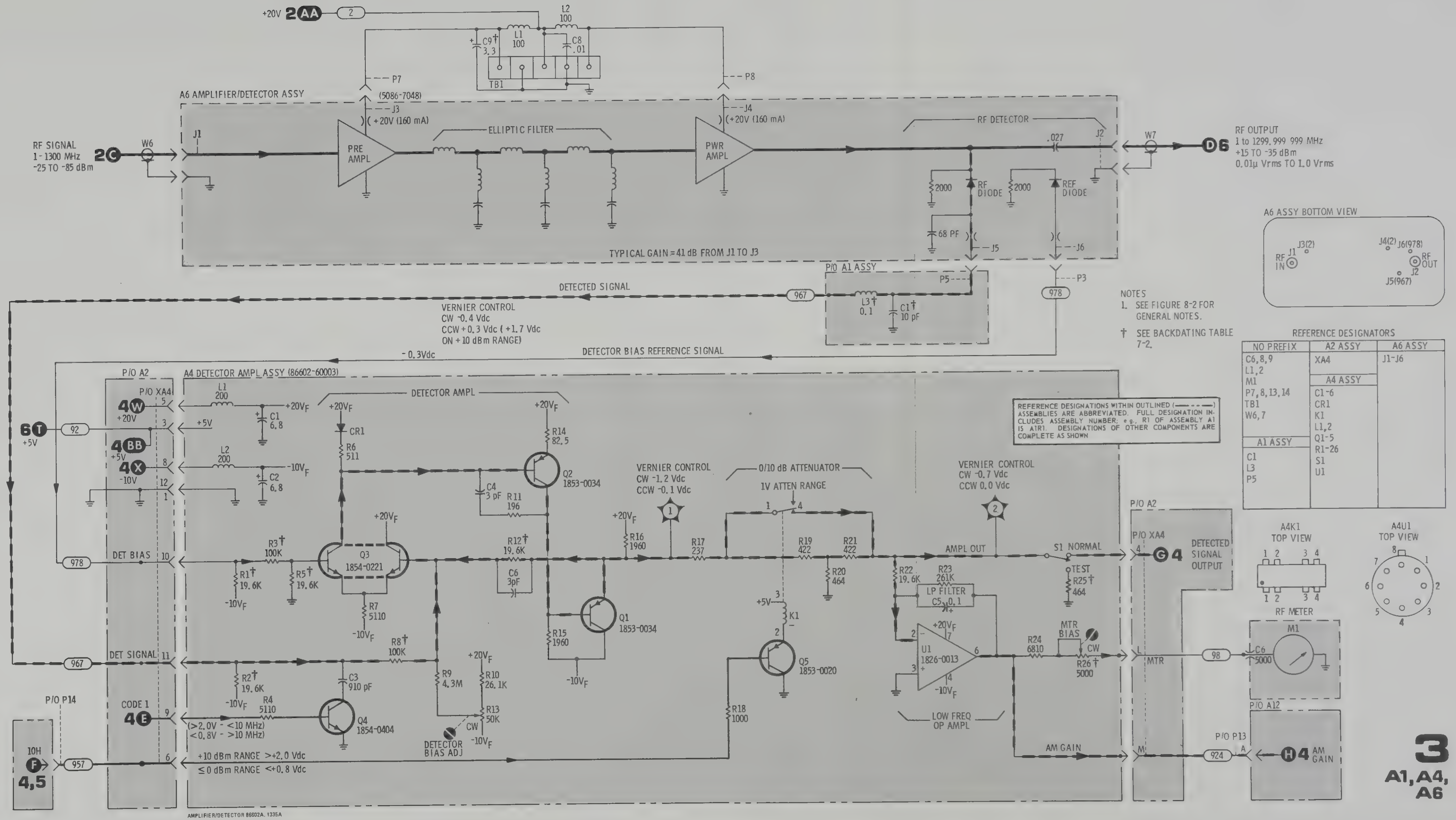


Figure 8-6. A4 Detector Amplifier Assembly Component and Test Point Locations



NOTES
1. SEE FIGURE 8-2 FOR GENERAL NOTES.
† SEE BACKDATING TABLE 7-2.

REFERENCE DESIGNATIONS WITHIN OUTLINED (——-·-——) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER; e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN

REFERENCE DESIGNATORS

NO PREFIX	A2 ASSY	A6 ASSY
C6,8,9 L1,2 M1 P7,8,13,14 TB1 W6,7	XA4	J1-J6
A1 ASSY	**A4 ASSY**	
C1 L3 P5	C1-6 CR1 K1 L1,2 Q1-5 R1-26 S1 U1	

Figure 8-7. Amplifier/Detector Schematic Diagram

SERVICE SHEET 4

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660-series mainframe manual to begin troubleshooting (Systems Troubleshooting Guide). If the information then indicates possible problems in the RF Section, refer to the Systems Troubleshooting information which preceeds Service Sheet 1 in this manual. This information may be used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, refer to Service Sheet 1 for further troubleshooting information.

PRINCIPLES OF OPERATION

General

The RF Detector input from the A4 Detector Amplifier Assembly is coupled into the A3 ALC Amplifier Assembly where it is compared to the reference input. Any difference in dc input levels causes an error output signal (i.e., a change from the loop quiescent state) at the difference amplifier output A3TP1. The error signal is coupled through the Gain-Shaping Amplifier to the A5 Modulator Assembly which controls the RF output level. The change in RF output level is reflected in a dc level change at the input to the dc amplifier. The change serves to balance the original error output signal at A3TP1.

A10 Reference Assembly

The Reference Assembly output is coupled to the ALC circuit where it is compared to the Detector Amplifier output. An error signal is generated which causes the RF signal to follow the reference dc level or, in AM mode, a low frequency ac signal which is superimposed on the reference dc output.

A reference dc level is established by A10VR1. This dc level is coupled to the inverting input of A10U1 where (in the +10 dBm range only) a small RF Detector diode linearity compensation current is added from the 10H input through resistor A10R14. The output of A10U1 passes through a remotely controlled attenuator or an adjustable voltage divider which includes R1 VERNIER Control. This provides fine adjustment of the reference output, i.e., the RF Output level over a 10 dB range.

The Amplitude Modulation drive signal is input at the non-inverting input of A10U1. The AM Gain input is a dc compensation signal which effects the level of the AM drive input. As the VERNIER control is rotated cw, the dc level goes more negative which increases the RF Output level. At the same time a negative change of the AM Gain compensation increases the modulation drive signal attenuation of the AM drive signal input to A10U1. The resulting increase in modulation drive signal at the output of A10U1 tends to keep the percentage modulation level constant with change in RF output level.

In the remote mode, the front panel VERNIER control of the RF output level is inhibited and the 1 dB step attenuator assumes "vernier" control over a 10 dB range. A logic low (<+0.8 Vdc) on the LCL/RMT input lines biases A10Q10 off, which opens the contacts of A10K6 and isolates the VERNIER control. At the same time, A10Q1 is biased on which closes the contacts of A10K5 and enables the 1 dB step attenuator. With no attenuation (RF vernier maximum) the 1A, 2A, 4A, and 8A inputs are all logic lows. Programmed attenuation levels will cause a logic high to appear on the appropriate input. For example, if 1 dB of attenuation is programmed (equivalent to a +2 dB front panel meter reading), a voltage of +5 Vdc will be found on A12XA10 pin J. This voltage biases A10Q9 off. Relay A10K1 opens which causes the reference to be attenuated through A10R21 and A10R22 (which is coupled to ground through A10Q8). When A10Q9 is turned off, bias current is supplied through A10R20 from the negative supply to turn A10Q8 on. Transistor A10Q8 is baised through the base-to-collector junction instead of the normal base-to-emitter junction.

Each step of attenuation is operated in the same manner. The values of the resistors in the voltage divider stick are weighted for greater attenuation of voltage output to the ALC circuits as the programmed attenuation levels are increased.

ALC Amplifier Assembly

The Detector Amplifier output, which is proportional to the RF output level, is compared to the Reference output in the ALC Amplifier Assembly.

The detector signal is coupled to the non-inverting input of the discrete operational amplifier (A3Q10, A3Q9, and associated components) while the reference input is coupled to the inverting input. Under normal operating conditions a change in reference input causes an error output signal at A3TP1. This signal passes through the Gain-Shaping Amplifier where it is coupled to the A5 Modulator Assembly. This change in Modulation Bias Signal causes the RF output to change. The change is reflected in the Detector Amplifier input to the ALC loop. This change serves to balance the error signal at A3TP1 and a new quiescent voltage is established. In a similar fashion, the change in RF output loading or a change in signal level input from the Frequency Extension Module is compensated for in the ALC loop. For example, a decrease in output level due to increased loading causes a positive change in the Detector Amplifier output to the ALC Amplifier. The resultant change in Modulator Bias Signal is negative which decreases the A5 Modulator Assembly Attenuation of the RF Signal and subsequently increases the RF output level.

At <10 MHz, a logic high (>+2.0 Vdc) at the Code 1 input biases A3Q5 off, A3Q2 is biased off, and A3Q3 is turned on. A3C6 is now coupled to ground which effectively reduces the bandwidth of the ALC loop. This occurs so the ALC loop does not respond to individual cyclic variations in the RF Signal but rather to the relatively long term peak output of the RF Detector.

Gain-Shaping Amplifier

The Gain-Shaping Amplifier is a discrete operational amplifier made up of A3Q7, A3Q8, A3Q6, A3Q11, A3Q4, and their associated components. The gain-shaping component is A3CR1. When A3CR1 is reverse biased the gain of the amplifier is unity (times one). As the instantaneous base voltage of A3Q6 is increased (by either positive dc level or positive excursions of an AM drive signal) A3CR1 is forward biased and the amplifier gain is dependent on the ratio of A3R3 and the effective resistance of A3CR1. This variable gain is used to compensate for the non-linearity of the A5 Modulator Assembly's input voltage to RF attenuation transfer function.

Pulse Modulation

In the Pulse Modulation mode (HP Model 86631B Auxiliary Section is used in place of a Modulation Section), a PULSE ID logic high (≈+5 Vdc) turns A3Q1 off which opens A3K1 and thus opens the ALC loop. At the same time, the PULSE ID input biases A2Q1 on, closes A2K1, and connects the Pulse In through A2R9, A2C2, and A2VR1 to the A5 Modulator Assembly. Withouth a pulse input, the positive bias through A2R8 biases the Modulator for maximum attenuation and reduces the power output to a minimum (>40 dB down). A −10 Vdc input pulse is required to cause the Moduator to exhibit minimum attenuation to the RF Signal.

TROUBLESHOOTING

It is assumed that the Troubleshooting information on Service Sheet 1 was used to isolate a circuit defect to the assemblies shown on the accompanying diagram. Troubleshoot the Reference and ALC Amplifier Assemblies and pulse modulation circuits by using the test equipment and procedures given below.

Test Equipment

Digital Voltmeter . . . . HP 34740A/34702A

Test 1. Check the power supply inputs to the A3 and A10 assemblies at A2XA3 pin 5 (+20V), pin 3 (+5V), and pin 8 (−10V) and A12XA10 pin D (+20V), pin C (+5V), and pin 5(−10V). If the voltages are correct proceed to Test 2. If incorrect, check the continuity of the inputs from the A12 Assembly.

Test 2. Check the Reference Output at P14 Pin E. If the output level is incorrect for the extreme settings of the vernier control or 1 dB Step Attenuator settings, (see schematic for levels) proceed to Test 3. If the output is correct, set A4S1 and check the levels at A3TP1 with the VERNIER (or 1 dB Step Attenuator) set to one extreme and then the other. If the output levels are normal, the Gain-Shaping Amplifier or the Modulator Bias Signal resistors are probably defective. Also check the Pulse ID input and the relays. Otherwise, the Difference Amplifier is probably defective.

Test 3. Check the reference diode A10VR1, and Reference Amplifiger A10U1 and their associated components. If the unit responds only to the local control or responds to remote control and not to the VERNIER, check the LCL/RMT input and the relay. If the reference output is incorrect in remote mode only, check the 1 dB Step Attenuator, relays, transistor switches, and other associated components. Small changes in RF Output level may be traceable to defective components coupled to the 10H input. If it was found that the amplitude modulation level varies with RF Output level, check the components associated with the AM Gain input. If the AM drive signal is reaching the RF Section, verify that it is reaching the A10 Assembly circuitry. Determine which component or part is defective, repair or replace it.

A4 Detector Amplifier Assembly
A6 Amplifier/Detector Assembly
◀SERVICE SHEET 3

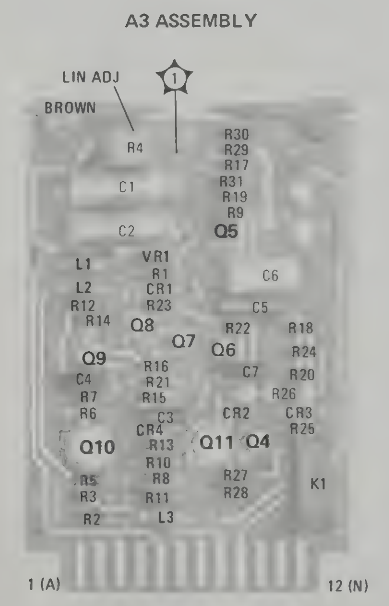


Figure 8-8. A3 ALC Amplifier Assembly Component and Test Point Locations

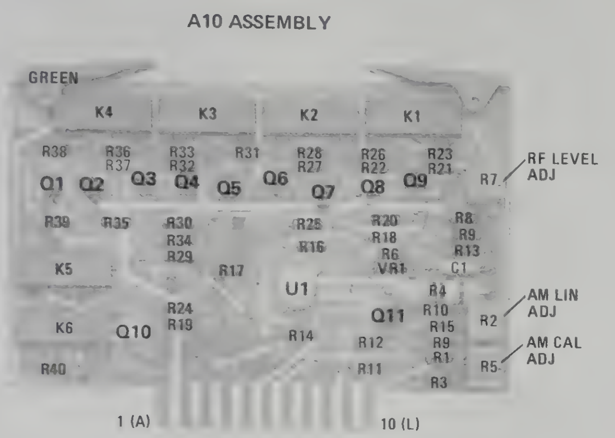
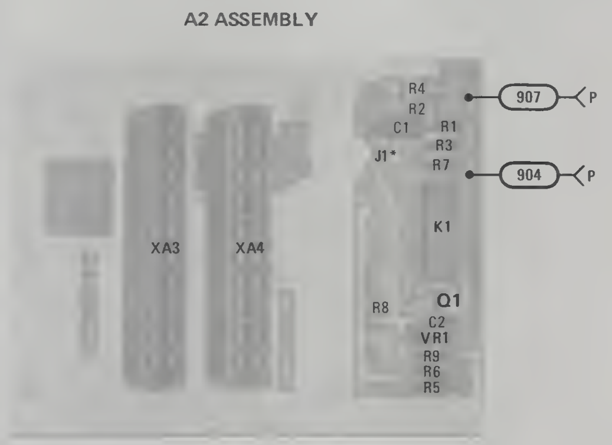
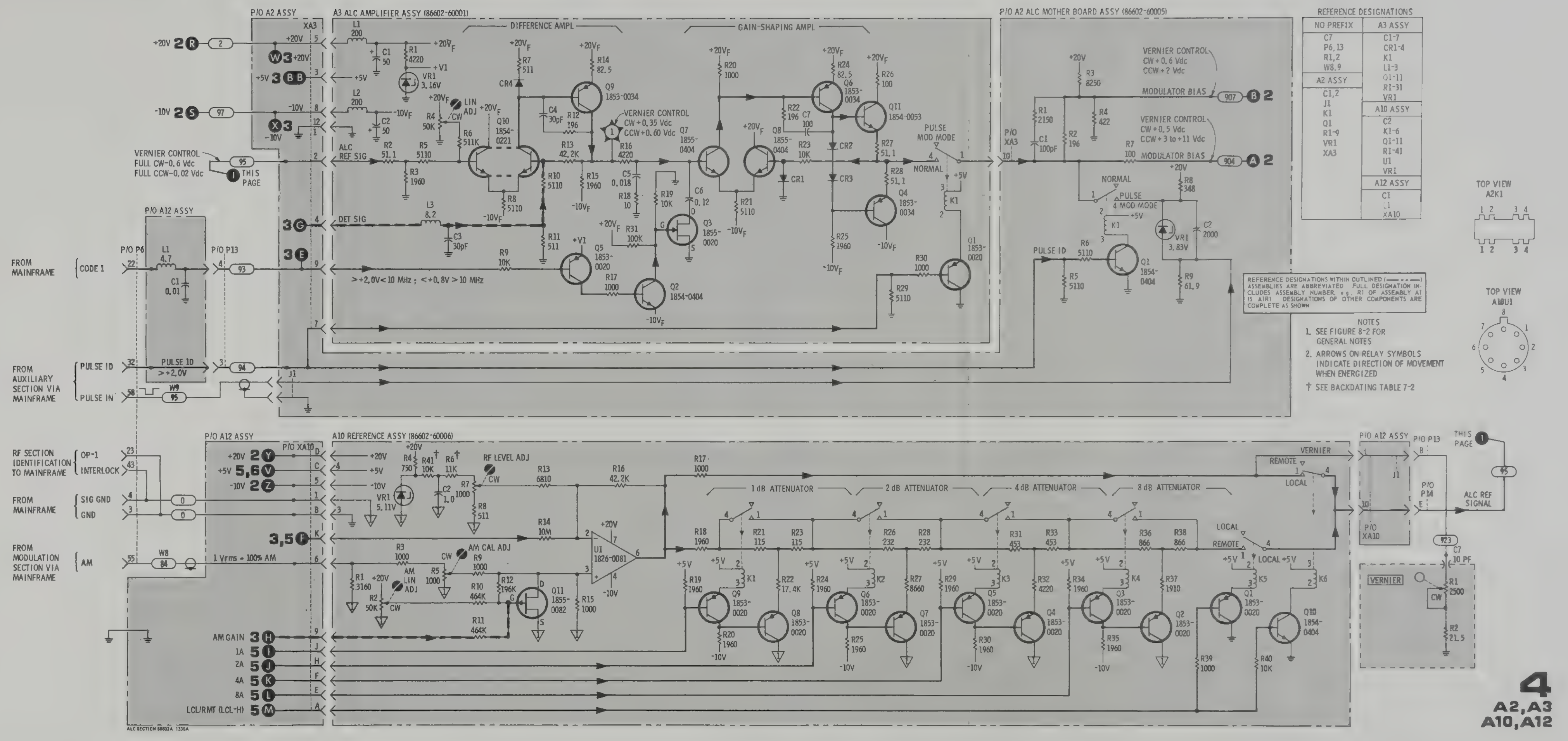


Figure 8-9. A10 Reference Assembly Component Locations



* NOTE: J1 ON OPPOSITE SIDE OF CIRCUIT BOARD.

Figure 8-10. A2 ALC Mother Board Assembly Component Locations



REFERENCE DESIGNATIONS

NO PREFIX	A3 ASSY
C7 P6,13 R1,2 W8,9	C1-7 CR1-4 K1 L1-3 Q1-11 R1-31 VR1
A2 ASSY	A10 ASSY
C1,2 J1 K1 Q1 R1-9 VR1 XA3	C2 K1-6 Q1-11 R1-41 U1 VR1
	A12 ASSY
	C1 L1 XA10

REFERENCE DESIGNATIONS WITHIN OUTLINED (— - - —) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER, e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.

NOTES

1. SEE FIGURE 8-2 FOR GENERAL NOTES
2. ARROWS ON RELAY SYMBOLS INDICATE DIRECTION OF MOVEMENT WHEN ENERGIZED

† SEE BACKDATING TABLE 7-2

Figure 8-11. ALC Section Schematic Diagram

SERVICE SHEET 5

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660-series mainframe manual to begin troubleshooting (Systems Troubleshooting Guide). If the information then indicates possible problems in the RF Section, refer to the Systems Troubleshooting information which preceeds Service Sheet 1 in this manual. This information is used to isolate the defect to the RF Section, another plug-in, or the mainframe. If the problem is in this plug-in, refer to Service Sheet 1 for preliminary troubleshooting information.

PRINCIPLES OF OPERATION

Local (Front panel) Control

The front panel OUTPUT RANGE switch provides a binary coded hexadecimal input (1F, 2F, 4F, 8F) and an over range input (1H) to the A11 Assembly in the local mode. The LCL/RMT input is logic high (>+1.3 Vdc) which causes the switch inputs to be gated directly to the outputs to the attenuator driver circuits and the 10H output. The following table shows the logic states of the inputs from the OUTPUT RANGE switch S1. The input signals are all active highs (attenuation) as are the outputs.

Local Inputs to All Logic Assembly

OUTPUT RANGE Switch Setting	Binary Coded Hexadecimal Input*				Over-Range Input*
	8F	4F	2F	1F	1H
+10	L	L	L	L	L
0	L	L	L	L	H
−10	L	L	L	H	H
−20	L	L	H	L	H
−30	L	L	H	H	H
−40	L	H	L	L	H
−50	L	H	L	H	H
−60	L	H	H	L	H
−70	L	H	H	H	H
−80	H	L	L	L	H
−90	H	L	L	H	H
−100	H	L	H	L	H
−110	H	L	H	H	H
−120	H	H	L	L	H
−130	H	H	L	H	H
−140	H	H	H	L	H

*L = <+0.8 Vdc: H = >+1.3 Vdc

SERVICE SHEET 5 (Cont'd)

Remote Operation

In the remote mode, 3 digits of BCD attenuation information are clocked into the A11 Assembly Shift Registers from the System mainframe. On the ATTN CLK input, a series of 10 pulses are received at pin K. These pulses are coupled to the trigger (T) input to the shift registers. The data input, which is synchronized with the pulses, contain no usable information for the first seven pulses. On the eighth pulse, units information is clocked into the left-handed column of registers with logic highs indicating data ones and lows indicating zeroes. On the ninth pulse, the units information is shifted to the center column of registers while tens information is entered into the left hand registers. On the tenth pulse, the units word is shifted into and stored in the right hand column, the tens information in the center registers, and the hundreds information in the left registers.

The BCD information stored in the units registers is coupled to the 1 dB Step Attenuator on the A10 Reference Assembly. (In local mode these outputs are not used. The VERNIER control is used for fine control of output level.)

The other two digits of BCD information are coupled to the BCD-to-Binary Decoder. The binary tens line actually bypasses the decoder because it expresses odd or even value in either the BCD or binary coded hexadecimal format. The second digit (20, 40 and 80) and third digit (100) in BCD format are output from the BCD-to-Binary Decoder in a 20, 40, and 80 binary format. With the tens level, these outputs are binary coded hexadecimal. In order to obtain the over-range output (10H), the 10, 20, 40 and 80 coded signals are inverted and coupled to a four input nand gate. The nand gate (over-range) output is low only with zero input attenuation (i.e., all the BCD-to-Binary Decoder output lines are low). The over-range level is coupled to A11 U5C and therefore to the 10H output. It is also coupled to the Full Adder along with the 10, 20, 40, and 80 lines. The inputs to the adder are connected so a value of 10 is subtracted from the input with the Over-Range inactive (high); when the over-range line is low the output follows the input directly. The following tables express the assembly inputs and outputs, the BCD-to-Binary converter inputs and outputs, and the Full Adder inputs and outputs. In each case, a level of >+2.0 Vdc is a logic high and <+0.8 Vdc is logic low.

SERVICE SHEET 5 (Cont'd)

Logic Assembly Inputs Versus Outputs

Programmed Attenuation Input						OUTPUT RANGE	Logic Assembly Output				
Decimal (dB)	2-Digit BCD					Decimal (dBm)					Over-range
	100	80	40	20	10		80L	40L	20L	10L	10H
0	L	L	L	L	L	+10	L	L	L	L	H
10	L	L	L	L	H	0	L	L	L	L	L
20	L	L	L	H	L	−10	L	L	L	H	L
30	L	L	L	H	H	−20	L	L	H	L	L
40	L	L	H	L	L	−30	L	L	H	H	L
50	L	L	H	L	H	−40	L	H	L	L	L
60	L	L	H	H	L	−50	L	H	L	H	L
70	L	L	H	H	H	−60	L	H	H	L	L
80	L	H	L	L	L	−70	L	H	H	H	L
90	L	H	L	L	H	−80	H	L	L	L	L
100	H	L	L	L	L	−90	H	L	L	H	L
110	H	L	L	L	H	−100	H	L	H	L	L
120	H	L	L	H	L	−110	H	L	H	H	L
130	H	L	L	H	H	−120	H	H	L	L	L
140	H	L	H	L	L	−130	H	H	L	H	L
150	H	L	H	L	H	−140	H	H	H	L	L

BCD-To-Binary Converter

Input				Output		
100	80	40	20	80	40	20
L	L	L	L	L	L	L
L	L	L	H	L	L	H
L	L	H	L	L	H	L
L	L	H	H	L	H	H
L	H	L	L	H	L	L
H	L	L	L	H	L	H
H	L	L	H	H	H	L
H	L	H	L	H	H	H

A2 ALC Mother Board Assembly
A3 ALC Amplifier Assembly
A10 Reference Assembly
◀SERVICE SHEET 4

SERVICE SHEET 5 (Cont'd)

Full Adder

Inputs					Outputs			
A_4	A_3	A_2	A_1	C_0, B_2, B_3, B_4	Σ_4	Σ_3	Σ_2	Σ_1
80	40	20	10	Over-range	80	40	20	10
L	L	L	L	L	L	L	L	L
L	L	L	H	H	L	L	L	L
L	L	H	L	H	L	L	L	H
L	L	H	H	H	L	L	H	L
L	H	L	L	H	L	L	H	H
L	H	L	H	H	L	H	L	L
L	H	H	L	H	L	H	L	H
L	H	H	H	H	L	H	H	L
H	L	L	L	H	L	H	H	H
H	L	L	H	H	H	L	L	L
H	L	H	L	H	H	L	L	H
H	L	H	H	H	H	L	H	L
H	H	L	L	H	H	L	H	H
H	H	L	H	H	H	H	L	L
H	H	H	L	H	H	H	L	H
H	H	H	H	H	H	H	H	L

Local Remote Multiplex

The LCL/RMT input is a logic low in the remote mode. This enables the gates which are connected to the remote attenuation inputs (Full Adder and Over-range) so the remote signals drive the 10 dB Step Attenuator. At the same time logic inputs from the OUTPUT RANGE switch are inhibited.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate a circuit defect to the assembly shown on the accompanying diagram. Troubleshoot the Logic Assembly by using the test equipment and procedures given below.

Test Equipment

Digital Voltmeter . . . HP 34740A/34702A

If the problem is evident only in the local mode of operation, check the OUTPUT RANGE switch, continuity of the connections to the A11 assembly, and the Local/Remote Multiplexer. Refer to the table showing the OUTPUT RANGE switch output. If the defect is evident only in the remote mode of operation, check the shift registers, the BCD-to-Binary Decoder, the Full Adder, and the Local/Remote Multiplexer for proper operation. Use the tables showing inputs versus outputs as a tool to isolate the defective component.

If the defect is evident in both the Local and Remote modes, the Local/Remote Multiplexer or an associated component is probably defective.

NOTE

If the inputs and outputs of the A11 Logic Assembly are correct, check the 10 dB step attenuator (Service Sheet 6) in all ranges, the 10 dB attenuator in the A4 Detector Amplifier Assembly, and the 1 dB Step Attenuator in the A10 Reference Assembly (also the 10H inputs and associated components). Also, check the 1 dB and 10 dB Step Attenuator outputs with attenuation inputs of 1, 2, 4, and 8 dB and 10, 20, 40, and 80 dB.

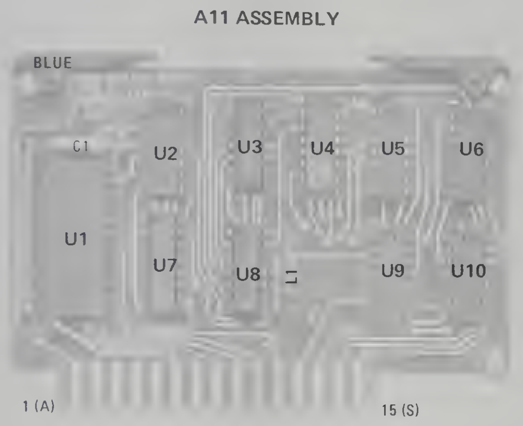
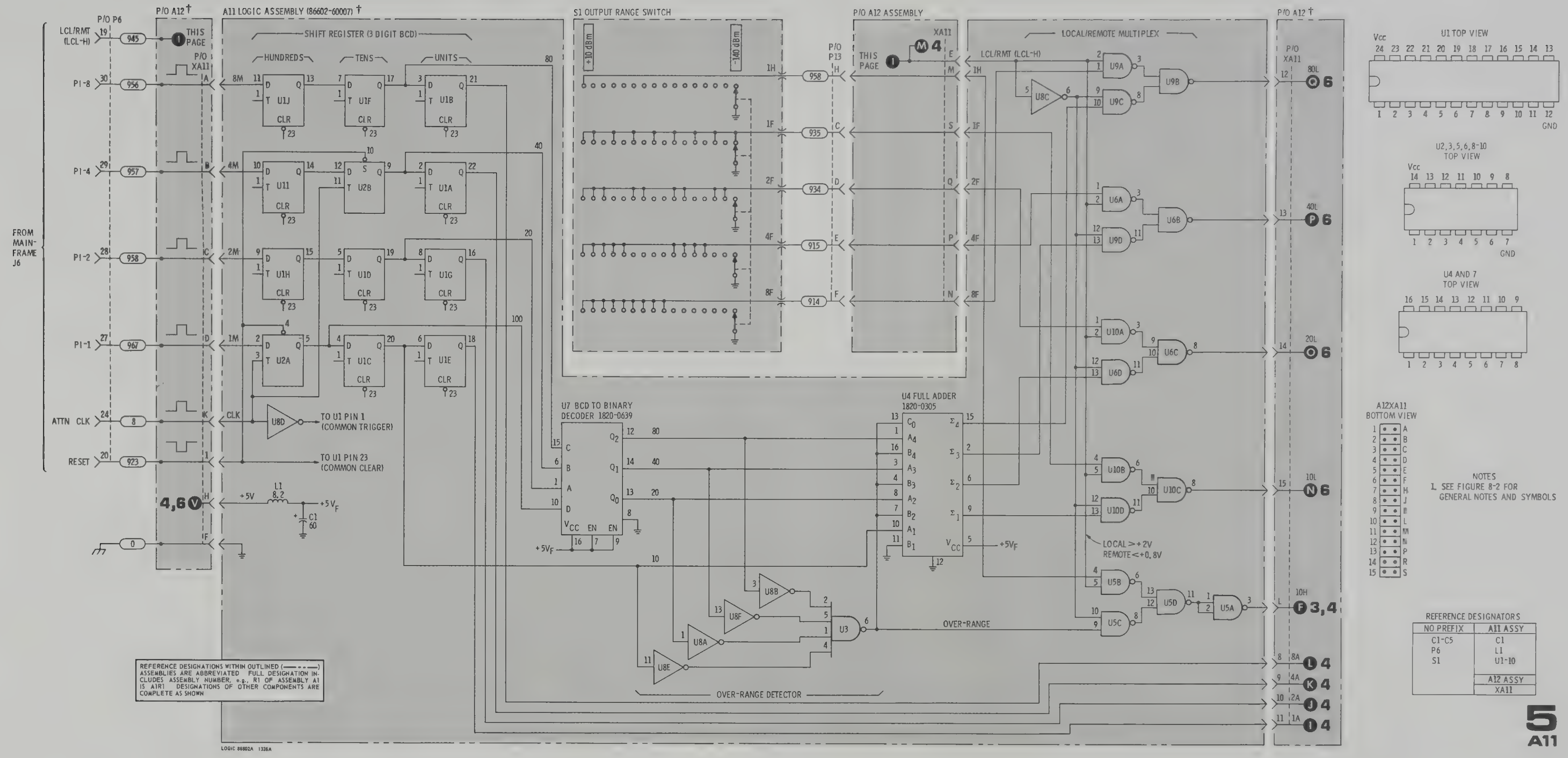


Figure 8-12. A11 Logic Assembly Component Locations



REFERENCE DESIGNATIONS WITHIN OUTLINED (—·—) ASSEMBLIES ARE ABBREVIATED FULL DESIGNATION INCLUDES ASSEMBLY NUMBER, e.g., R1 OF ASSEMBLY A1 IS A1R1 DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN

NOTES

1. SEE FIGURE 8-2 FOR GENERAL NOTES AND SYMBOLS

REFERENCE DESIGNATORS

NO PREFIX	A11 ASSY
C1-C5 P6 S1	C1 L1 U1-10
	A12 ASSY
	XA11

Figure 8-13. A11 Logic Assembly Schematic Diagram

SERVICE SHEET 6

NOTE

When a malfunction occurs, refer to Section VIII of the Model 8660-series mainframe manual to begin troubleshooting (System Troubleshooting Guide). If the information then indicates possible problems in the RF Section, refer to the Systems Troubleshooting information which preceeds Service Sheet 1 in this manual. This information may be used to isolate the defect to the RF Section, another plug-in or the mainframe. If the problem is in this plug-in refer to Service Sheet 1 for further troubleshooting information before returning here.

PRINCIPLES OF OPERATION

A logic high inputs (>+2.0 Vdc) from the A11 Logic board Assembly will cause the driver transistors to supply current to switch the appropriate attenuator section in the A13 Attenuator Assembly. For example, if 10 dB of attenuation is desired, the 10L input goes high, A9Q15 is biased on; A9Q11 is also biased on and supplies driving current to switch A13K1. The relay arms all drop down into the lower position. The RF Signal flow is now through attenuator section AT1 (10 dB). The two lower relay arms provide a latching function for the relay. This means that until a drive current of the correct polarity is input to the A9 Attenuator Drive Assembly, the relay is latched in its present state. Also, no current flows after the switching has been completed. A9R3 and A9VR1 provide the proper bias level for the input transistors so they will respond correctly to the inputs. A9CR1 and A9CR2 provide protection for the driver transistors from the inductive switching transient which occurs when the drive current through the relays is turned off.

The other attenuator sections function the same way as the 10 dB section. However, the 80 dB section actually uses two 40 dB sections in parallel.

TROUBLESHOOTING

It is assumed that the troubleshooting information on Service Sheet 1 was used to isolate a circuit defect to the assemblies shown on the accompanying diagram. Troubleshoot the Attenuator and Attenuator Driver Assemblies using the test equipment and procedures given below.

Test Equipment

Digital Voltmeter . . . HP 34740A/34702A

The malfunction may be isolated to either the A13 or A9 assemblies by measuring the 10D, 20D, 40D, and 80D control lines and determining if they are correct. If the problem is in the A13 Assembly DO NOT attempt to repair it. It is not a field repairable unit.

◀ A11 Logic Assembly
SERVICE SHEET 5

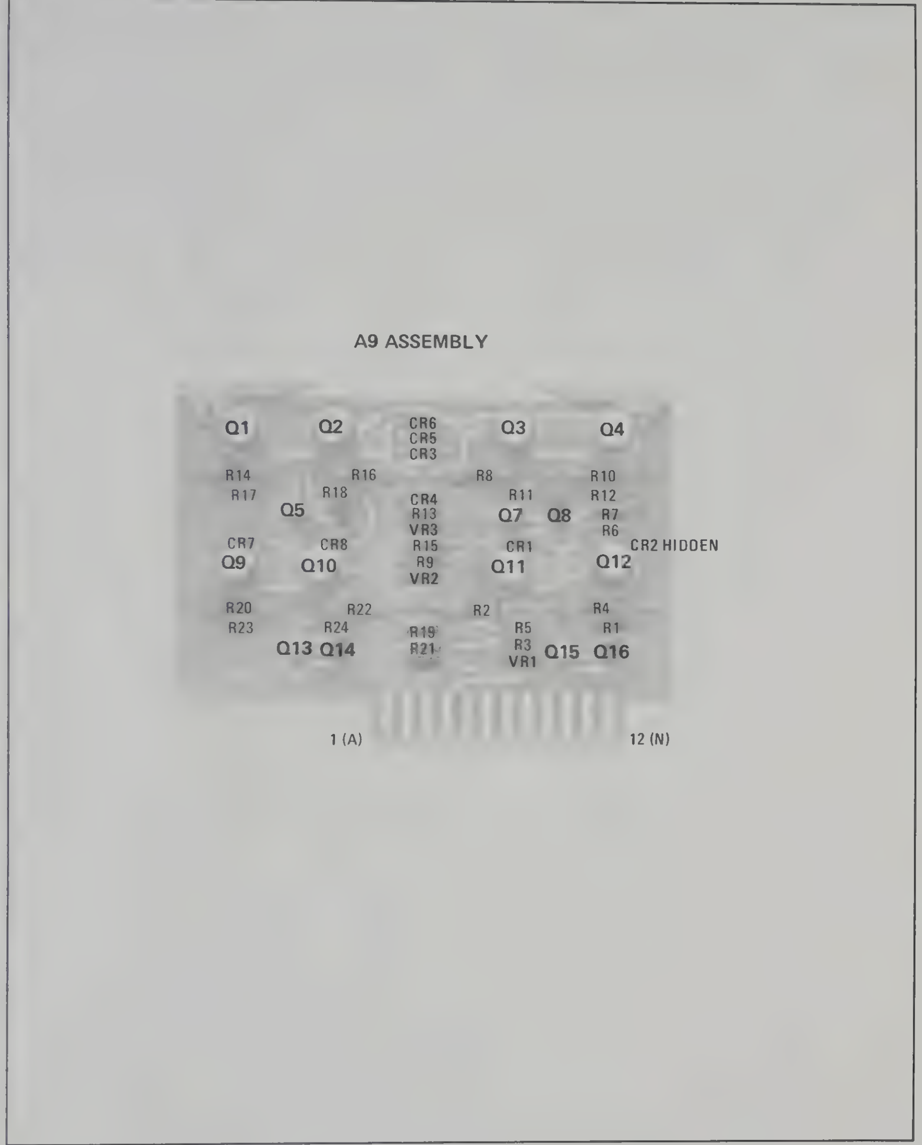
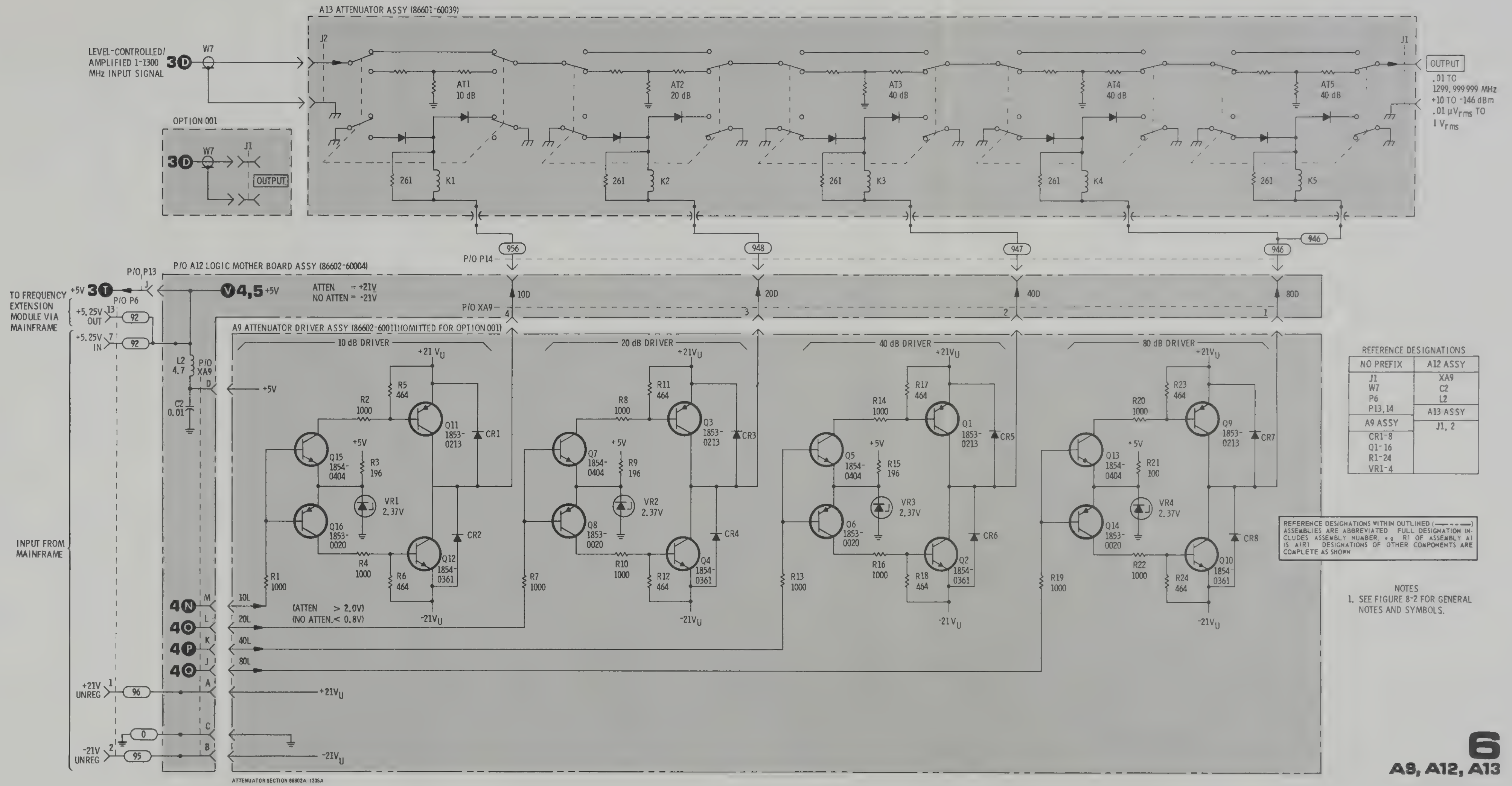


Figure 8-14. A9 Attenuator Driver Assembly Component Locations



REFERENCE DESIGNATIONS

NO PREFIX	A12 ASSY
J1 W7 P6 P13, 14	XA9 C2 L2
A9 ASSY	A13 ASSY
CR1-8 Q1-16 R1-24 VR1-4	J1, 2

REFERENCE DESIGNATIONS WITHIN OUTLINED (—— - - ——) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER, e.g. R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN.

NOTES

1. SEE FIGURE 8-2 FOR GENERAL NOTES AND SYMBOLS.

6
A9, A12, A13

Figure 8-15. Attenuator Section Schematic Diagram

REMOVAL AND DISASSEMBLY PROCEDURES

CAUTION

Before removing the RF Section plug-in from the mainframe, remove the line (Mains) voltage by disconnecting the power cable from the power outlet.

RF Section Plug-in Removal

a. Release the latch below the OUTPUT jack.

b. Pull the latch out while rotating it to the left until it is perpendicular to the front panel. This pulls the mating plugs and jacks apart (plug-in to mainframe).

c. Grasp the latch and pull the plug-in straight out from mainframe.

Plug-in Cover Removal

a. Remove the 16 pozidriv screws from both covers.

b. Loosen the 4 screws which hold the teflon/aluminum plug-in guide in place.

c. Remove the covers and set them aside.

d. If necessary, remove the plug-in guides by removing the screws.

Front Panel Disassembly

a. Place the RF Section in the normal upright position.

b. With a Pozidriv screwdriver, remove the two screws which hold the top of the front panel to the housing.

c. Turn the plug-in over with the bottom up. Remove the screw which is seen through the curved cutout slot in the latch when it is in the closed or latched position.

d. With a knurled nut wrench, loosen the knurled nut on the OUTPUT jack. Remove the nut by hand.

e. Pull the front panel away from the housing.

Interconnection of RF Section to Mainframe for Troubleshooting Purposes

After the RF Section is removed from the mainframe and its covers have been removed, the RF Section must be reconnected to the mainframe with interconnecting extender cables before troubleshooting can begin.

WARNING

With the mainframe top cover removed, power is supplied to the system during troubleshooting. Energy available at many points may, if contacted, result in personal injury.

a. Remove the mainframe top cover. First remove the 4 Pozidriv screws; then slide the cover back and off the mainframe siderails.

NOTE

The interconnect cables and adaptors are parts found in the HP 11672A Service Kit. They may all be ordered in the kit or as individual pieces. Refer to the 11672A Operating Note for a pictorial cross reference.

b. Make connection from J6 (mainframe) to P6 (RF Section rear panel) with the 11672-60001 multi-pin interconnect cable.

WARNING

To avoid contact with the line voltage, remove the line (main) power cable from the power outlet before removing or connecting cables to the Frequency Extension Module.

c. Connect the 1250-1236 adaptor to the 11672-60005 gray coaxial cable. Insert the adaptor into P2.

d. Remove the gray-blue cable from the jack on the rear side of the Frequency Extension Module. Connect the gray coaxial cable to the extension module jack.

e. Take the 11672-60004 red coaxial cable and connect it to P1 (RF Section rear panel below the multi-pin connector).

f. Disconnect the gray cable from the other extension module output jack. Connect the coaxial cable to the jack.

g. Reconnect the mainframe line (Main) power cable to the power outlet and set the mainframe line switch to ON.

Installation and Reassembly Procedures

To install or reassemble the front panel and covers, follow the previous procedures in reverse. To reinstall the RF Section plug-in to the mainframe, instructions may be found in Section II. Follow the interconnection procedures in reverse in connecting the coaxial cables from the Frequency Extension Module to RF Section back to the proper extension module output jack.

Table 8-4. Assemblies, Chassis Mounted Parts, and Adjustable Component Locations (1 of 2)

Reference Designator	Service Sheet	Figures	Remarks
A1 Assembly	1, 2, 3	—	Circuit board, mounted opposite side of aluminum deck from A5 and A6
A2 Assembly	1, 2, 4	8-10, 16	
A3 Assembly	1, 4	8-8, 16	
A3R4 Control	4	8-8, 16	8-16, Top View
A4 Assembly	1, 3	8-6, 16	
A4R6 Control	3	8-6, 16	8-16, Top View
A4R13 Control	3	8-6, 16	8-16, Top View
A4S1	1, 3	8-6, 16	8-16, Top View
A5 Assembly	1, 2	8-16	
A6 Assembly	1, 3	8-16	
A7 Assembly	1, 2	8-16	Top View
A8 Assembly	1, 2	8-16	
A9 Assembly	1, 6	8-14, 16	8-16, Left Sideview
A10 Assembly	1, 4	8-9, 16	8-16, Left Sideview
A10R2 Control	4	8-9, 16	8-16, Top View
A10R5 Control	4	8-9, 16	8-16, Top View
A10R7 Control	4	8-9, 16	8-16, Top View
A11 Assembly	1, 5	8-12, 16	8-16 Left Sideview
A12 Assembly	4, 6	8-16	Top View (A9, A10, and A11 plug into connectors mounted on A12)
A13 Assembly	1, 6	8-16	
A14 Assembly	—	8-16	
A15 Assembly	1, 2	8-16	Left Sideview (mounted beside P6)
AT1	1, 2	8-16	Top View
C1-5	1, 5	8-16	Left Sideview (cross section)
C6	1, 3	8-16	Left Sideview (cross section)
C7	1, 4	8-16	Left Sideview (cross section)
C8, 9	3	—	Connected to TB1
FL1	1, 2	8-16	
J1	6	8-16	Bottom View
L1, 2	3	—	Connected to TB1
M1	1, 3	3-1, 8-16	8-16, Front Panel Internal

Table 8-4. Assemblies, Chassis Mounted Parts, and Adjustable Component Locations (2 of 2)

Reference Designator	Service Sheet	Figures	Remarks
P1, 2	1, 2	3-1	P1 is ❽, P2 is ❻
P3	1, 3	—	Connected to A6 Assembly
P4, 5	2	—	+20V to A8 Assembly
P6	1, 2, 4, 5, 6	3-1, 8-16	3-1, P6 is ❼; 8-16, Left Sideview
P7, 8	3	—	+20V to A6 Assembly
P13	3, 4, 6	8-16	Top View
P14	3, 6	—	Found below P13 on instrument right side
R1, 2	4	8-16	Front Panel Internal
S1	1, 5	8-16	Front Panel Internal
TP1	3	8-16	Top View
W1	1, 2	8-16	Bottom View, Black, P1 to A8 Assembly
W2*	1, 2	8-16	A8 Assy to FL1
W3	1, 2	8-16	Top View, black, P2 to AT1
W4*	1, 2	8-16	AT1 to A5 Assy
W5*	1, 2	8-16	A5 Assy to A7 Assy
W6*	1, 2, 3	8-16	A7 Assy to A6 Assy
W7*	1, 3, 6	8-16	A6 Assy to A13 Assy
W8	1, 4	8-16	Gray-yellow, P6 to A12 Assy
W9	1, 4	8-16	White-green, P6 to A2 Assy
W10*	1, 2	8-16	FL1 to A7 Assy
W11**	1, 2	—	White-blue P6 to A15 Assy
W12**	1, 2	—	White-red A15 Assy to P6
W13**	1, 2	—	White-brown P6 to P6
W14**	1, 2	—	White-orange P6 to P6
W15**	1, 2	—	White-yellow P6 to P6

* Indicates semi-rigid coaxial cable
** RF Coaxial Interconnection cables to Frequency Extension Module

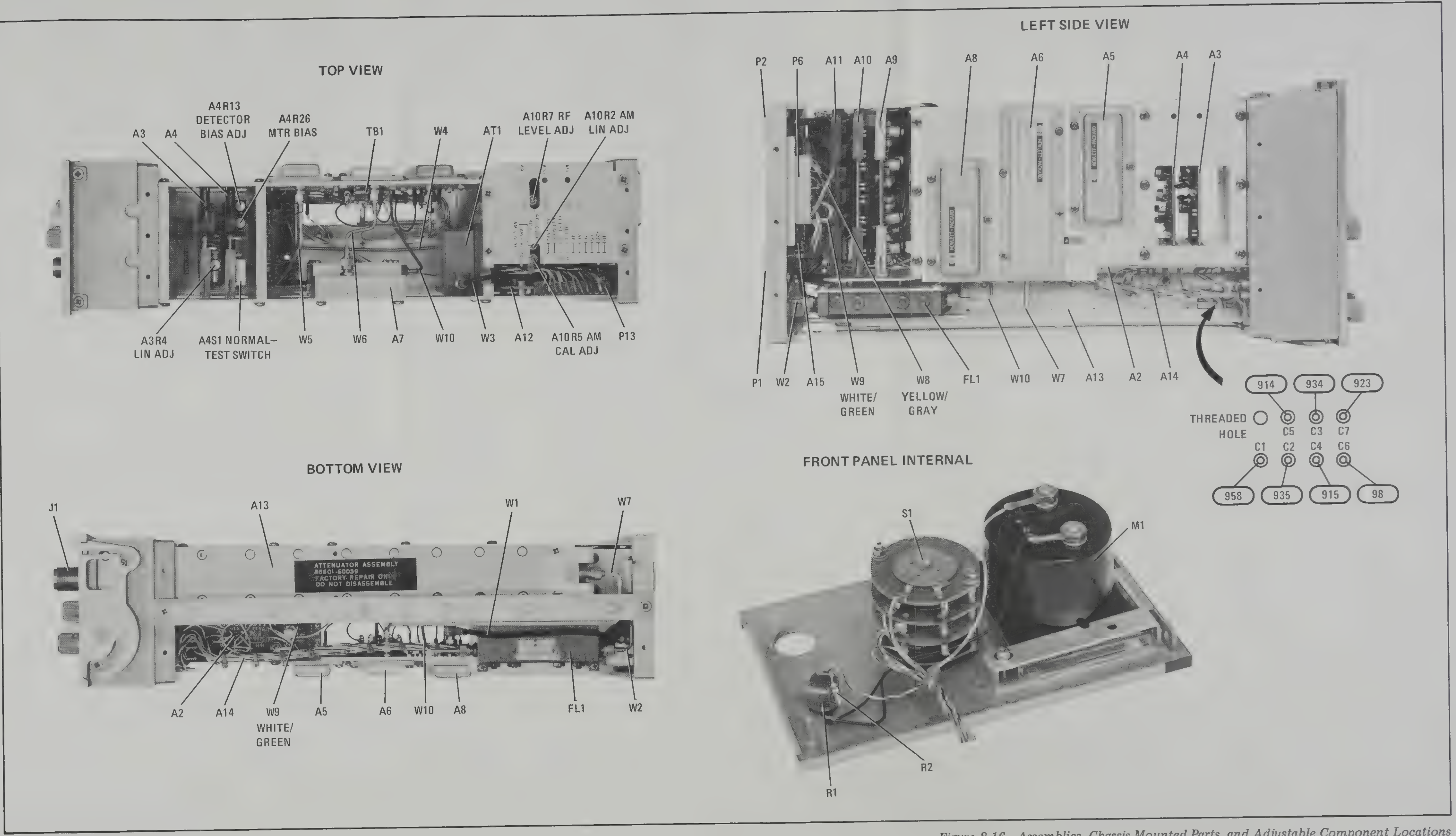


Figure 8-16. Assemblies, Chassis Mounted Parts, and Adjustable Component Locations

Assemblies, Chassis Mounted Parts, and Adjustable Component Locations

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MANUAL CHANGES

MANUAL IDENTIFICATION
Model Number: 86602A
Date Printed: Sept. 1974
Part Number: 86602-90011

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
1441A	1		
1444A	1, 2		

► NEW ITEM

CHANGE 1

Page 6-5, Table 6-2:

Change A4R6 to 0698-3155, RESISTOR 4.64K 1% .125W F TUBULAR, 16299, C4-1/8-TO-4641-F.

Change A4R14 to 0757-0420, RESISTOR 750 OHM 1% .125W F TUBULAR, 24546, C4-1/8-TO-751-F.

Page 8-17, Figure 8-7 (Service Sheet 3):

Change the value of A4R6 to 4640 and A4R14 to 750.

CHANGE 2

Page 6-6 and 6-7:

Replace the A9 assembly parts list with Table 6-2 on page 2 of this supplement.

Page 8-23:

Replace Figure 8-14 with the component location diagram on page 3 of this supplement.

Replace Figure 8-15 with the schematic on page 4 of this supplement.

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

2 December 1974

4 Pages

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Table 6-2. *Replaceable Parts (P/O Change 2)*

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Numbe
A9	86602-60040	1	ATTENUATOR DRIVER ASSY	28480	86602-60040
A9CR1	1901-0025	8	DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR2	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR3	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR4	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR5	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR6	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR7	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9CR8	1901-0025		DIODE-GEN PRP 100V 200MA	28480	1901-0025
A9Q1	1853-0213	4	TRANSISTOR PNP 2N4236 SI CHIP PD=1W	04713	2N4236
A9Q2	1854-0361	4	TRANSISTOR NPN 2N4239 SI PD=800MW	04713	2N4239
A9Q3	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A9Q4	1854-0071	8	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q5	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A9Q6	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A9Q7	1853-0213		TRANSISTOR PNP 2N4236 SI CHIP PD=1W	04713	2N4236
A9Q8	1854-0361		TRANSISTOR NPN 2N4239 SI PD=800MW	04713	2N4239
A9Q9	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A9Q10	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q11	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A9Q12	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A9Q13	1853-0213		TRANSISTOR PNP 2N4236 SI CHIP PD=1W	04713	2N4236
A9Q14	1854-0361		TRANSISTOR NPN 2N4239 SI PD=800MW	04713	2N4239
A9Q15	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A9Q16	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q17	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A9Q18	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A9Q19	1853-0213		TRANSISTOR PNP 2N4236 SI CHIP PD=1W	04713	2N4236
A9Q20	1854-0361		TRANSISTOR NPN 2N4239 SI PD=800MW	04713	2N4239
A9Q21	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A9Q22	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A9Q23	1854-0404		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0404
A9Q24	1853-0020		TRANSISTOR PNP SI CHIP PD=300MW	28480	1853-0020
A9R1	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A9R2	0757-0159	8	RESISTOR 1K 1% .5W F TUBULAR	19701	MF7C1/2-T0-1R0-F
A9R3	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	19701	MF7C1/2-T0-1R0-F
A9R4	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-196R-F
A9R5	0811-2815	8	RESISTOR 1.5 OHM 5% .5W PW TUBULAR	91637	RS1/2-T2-1R5-J
A9R6	0811-2815		RESISTOR 1.5 OHM 5% .5W PW TUBULAR	91637	RS1/2-T2-1R5-J
A9R7	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A9R8	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A9R9	0698-4002	8	RESISTOR 5K 1% .125W F TUBULAR	16299	C4-1/8-T0-5001-F
A9R10	0698-4002		RESISTOR 5K 1% .125W F TUBULAR	16299	C4-1/8-T0-5001-F
A9R11	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A9R12	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	19701	MF7C1/2-T0-1R0-F
A9R13	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	19701	MF7C1/2-T0-1R0-F
A9R14	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-196R-F
A9R15	0811-2815		RESISTOR 1.5 OHM 5% .5W PW TUBULAR	91637	RS1/2-T2-1R5-J
A9R16	0811-2815		RESISTOR 1.5 OHM 5% .5W PW TUBULAR	91637	RS1/2-T2-1R5-J
A9R17	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A9R18	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A9R19	0698-4002		RESISTOR 5K 1% .125W F TUBULAR	16299	C4-1/8-T0-5001-F
A9R20	0698-4002		RESISTOR 5K 1% .125W F TUBULAR	16299	C4-1/8-T0-5001-F
A9R21	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A9R22	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	19701	MF7C1/2-T0-1R0-F
A9R23	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	19701	MF7C1/2-T0-1R0-F
A9R24	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-196R-F
A9R25	0811-2815		RESISTOR 1.5 OHM 5% .5W PW TUBULAR	91637	RS1/2-T2-1R5-J
A9R26	0811-2815		RESISTOR 1.5 OHM 5% .5W PW TUBULAR	91637	RS1/2-T2-1R5-J
A9R27	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A9R28	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A9R29	0698-4002		RESISTOR 5K 1% .125W F TUBULAR	16299	C4-1/8-T0-5001-F
A9R30	0698-4002		RESISTOR 5K 1% .125W F TUBULAR	16299	C4-1/8-T0-5001-F
A9R31	0757-0280		RESISTOR 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A9R32	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	19701	MF7C1/2-T0-1R0-F
A9R33	0757-0159		RESISTOR 1K 1% .5W F TUBULAR	19701	MF7C1/2-T0-1R0-F
A9R34	0698-3440		RESISTOR 196 OHM 1% .125W F TUBULAR	16299	C4-1/8-T0-196R-F
A9R35	0811-2815		RESISTOR 1.5 OHM 5% .5W PW TUBULAR	91637	RS1/2-T2-1R5-J
A9R36	0811-2815		RESISTOR 1.5 OHM 5% .5W PW TUBULAR	91637	RS1/2-T2-1R5-J
A9R37	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A9R38	0757-0401		RESISTOR 100 OHM 1% .125W F TUBULAR	24546	C4-1/8-T0-101-F
A9R39	0698-4002		RESISTOR 5K 1% .125W F TUBULAR	16299	C4-1/8-T0-5001-F
A9R40	0698-4002		RESISTOR 5K 1% .125W F TUBULAR	16299	C4-1/8-T0-5001-F
A9VR1	1902-3002	4	DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=	04713	SZ 10939-2
A9VR2	1902-3002		DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=	04713	SZ 10939-2
A9VR3	1902-3002		DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=	04713	SZ 10939-2
A9VR4	1902-3002		DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=	04713	SZ 10939-2

See introduction to this section for ordering information

A9

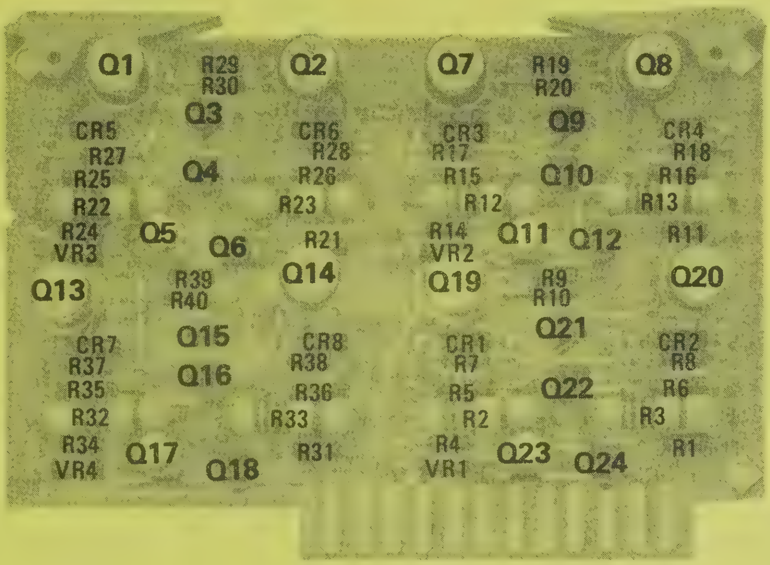
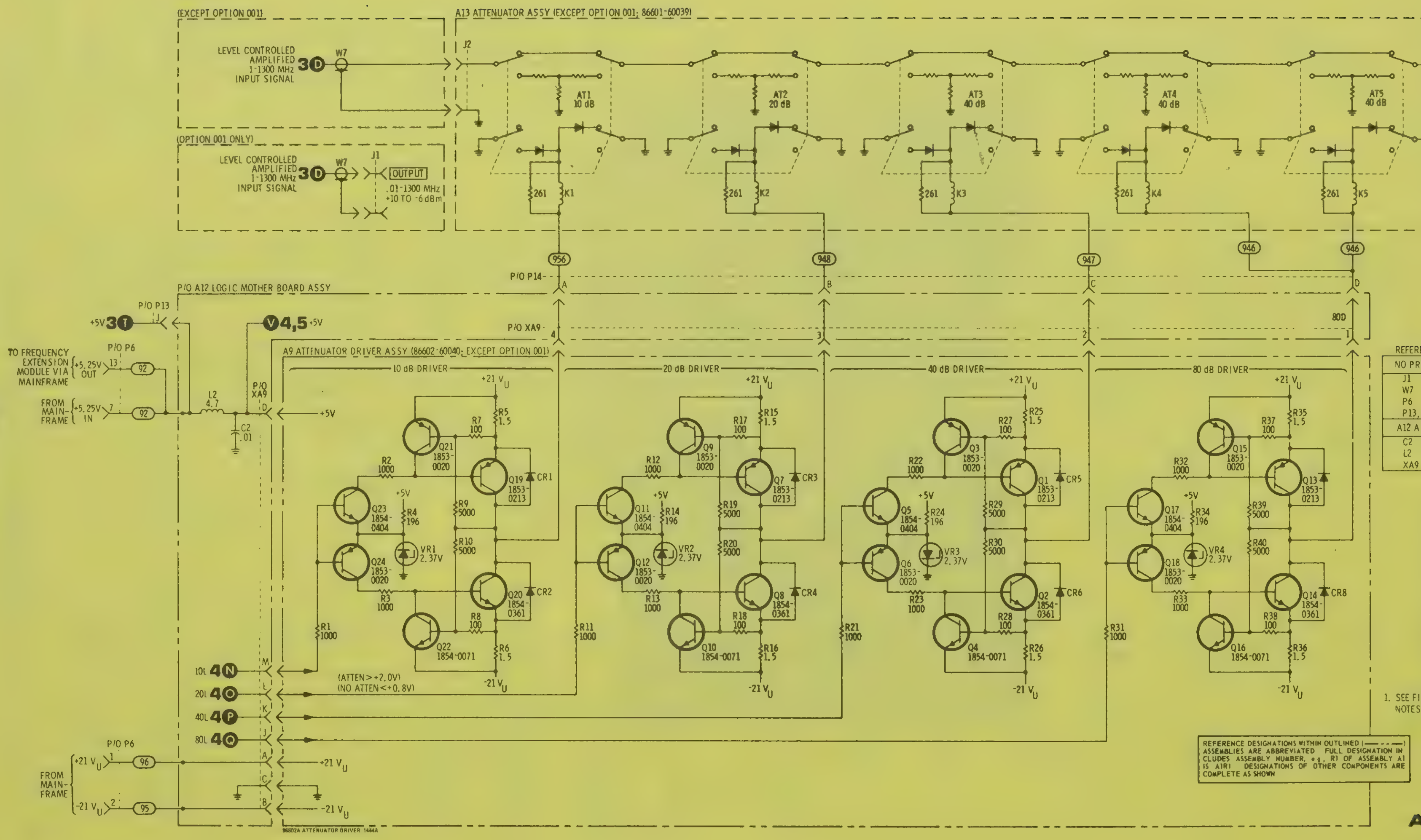


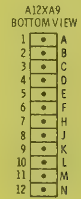
Figure 8-14. A9 Attenuator Driver Assembly Component Locations (P/O Change 2)



REFERENCE DESIGNATIONS WITHIN OUTLINED (— - - —) ASSEMBLIES ARE ABBREVIATED. FULL DESIGNATION INCLUDES ASSEMBLY NUMBER, e.g., R1 OF ASSEMBLY A1 IS A1R1. DESIGNATIONS OF OTHER COMPONENTS ARE COMPLETE AS SHOWN

REFERENCE DESIGNATIONS

NO PREFIX	A13 ASSY
J1 W7 P6 P13, 14	CR1-8 Q1-24 R1-40 VR1-4
A12 ASSY	
C2 L2 XA9	



NOTES

1. SEE FIGURE 8-2 FOR GENERAL NOTES AND SYMBOLS

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A9, A12, A13

Figure 8-15. Attenuator Section Schematic Diagram (P/O Change 2)

OPERATING INFORMATION

RF SECTION
1-1300 MHz

86602A

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MODEL 86602A

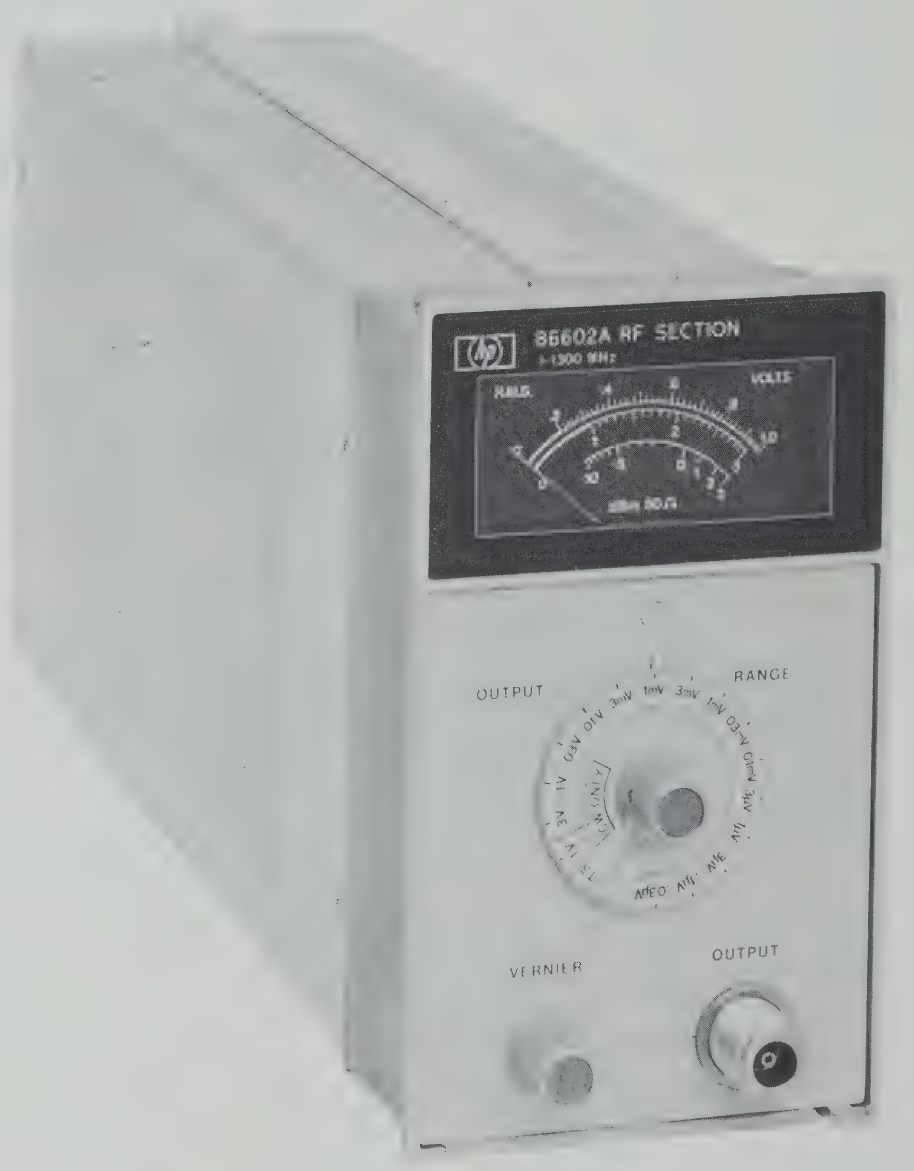


Figure 1-1. HP Model 86602A RF Section

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains all information required to install, operate, test, adjust and service the Hewlett-Packard Model 86602A RF Section plug-in, hereinafter referred to as the 86602A. For information concerning related equipment, such as the Hewlett-Packard Models 8660A and 8660B Synthesized Signal Generator mainframes or the Model 11661A Frequency Extension Module, refer to the appropriate manual or manuals.

1-3. This manual is divided into eight sections which provide information as follows:

a. SECTION I, GENERAL INFORMATION, contains the instrument description and specifications as well as the accessory and recommended test equipment list.

b. SECTION II, INSTALLATION, contains information relative to receiving inspection, preparation for use, mounting, packing, and shipping.

c. SECTION III, OPERATION, contains operating instructions for the instrument.

d. SECTION IV, PERFORMANCE TESTS, contains information required to verify that instrument performance is in accordance with published specifications.

e. SECTION V, ADJUSTMENTS, contains information required to properly adjust and align the instrument after repair.

f. SECTION VI, REPLACEABLE PARTS, contains information required to order all parts and assemblies or effect exchange of assemblies.

g. SECTION VII, MANUAL CHANGES, contains backdating information to make documentation in this manual applicable to all earlier versions of this instrument.

h. SECTION VIII, SERVICE, contains descriptions of the circuits, schematic diagrams, parts location diagrams, and troubleshooting procedures to aid the user in maintaining the instrument.

1-4. Figure 1-1 shows the HP Model 86602A RF Section.

1-5. Packaged with this manual is an Operating Information Supplement. This is simply a copy of the first three sections of this manual. This supplement should stay with the instrument for use by the operator. Additional copies of the Operating Information Supplement may be ordered separately through your nearest Hewlett-Packard office. The part number is listed on the title page of this manual.

1-6. On the title page of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 4 x 6-inch microfilm transparencies of the manual. Each microfiche contains up to 60 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

1-7. SPECIFICATIONS

1-8. Instrument specifications are listed in Table 1-1. These specifications are the performance standards, or limits against which the instrument may be tested.

1-9. INSTRUMENTS COVERED BY MANUAL

1-10. This instrument has a two-part serial number. The first four digits and the letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under SERIAL NUMBERS on the title page.

1-11. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted serial prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a yellow Manual Changes supplement that contains "change information" that documents the differences.

Table 1-1. Models 86602A/11661 Specifications (1 of 2)

SPECIFICATIONS

FREQUENCY CHARACTERISTICS

Range: 1.0 to 1299.999 999 MHz. Selectable in 1 Hz steps. Frequencies from 200 kHz to 1 MHz may also be selected with some degradation in specifications.

Accuracy and Stability: CW frequency accuracy and long term stability are determined by reference oscillator in 8660-series Mainframe (3 X 10^{-8}/24 hours) or by external reference if used.

Switching Time:

6 ms to be within 50 Hz of any new frequency selected.

100 ms to be within 5 Hz of any new frequency selected.

Largest Digit Changed	1 Hz 10 Hz	100 Hz	1 kHz, 10 kHz	100 kHz, 1 MHz	10 MHz	100 MHz, 1 GHz
Error at: 1 msec	<1 Hz	<100 Hz	< 500 Hz	<500 Hz	<500 Hz	Undefined
5 msec	<1 Hz	<1 Hz	<10 Hz	<50 Hz	<50 Hz	<50 Hz

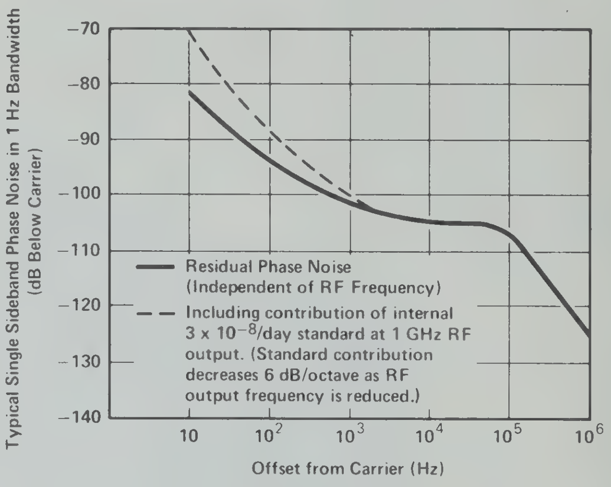
Typical 86602A/11661
Frequency Switching Characteristics

Harmonic Signals: All harmonically related signals are at least 30 dB below the desired output signal for output levels below +3 dBm. (−25 dB for output levels above +3 dBm.)

Spurious Signals:
Below 700 MHz, −80 dB.
Above 700 MHz, −80 dB within 45 MHz of carrier. −70 dB greater than 45 MHz from carrier (−50 dB on 1V range).
Power Line Related: −70 dB.

Signal-to-Phase Noise Ratio: Greater than 45 dB in a 30 kHz band centered on the signal excluding a 1 Hz band centered on the carrier.

Typical SSB Phase Noise Curve:



Typical 86602A Phase Noise

Residual FM: <1.5 Hz rms in a 2 kHz bandwidth centered on the carrier (CW, AM only).

Signal-to-AM Noise Ratio: Greater than 65 dB in a 30 kHz bandwidth centered on the carrier at output level of +10 dBm

OUTPUT CHARACTERISTICS

Level: Continuously adjustable from +10 to −146 dBm (0.7V to 0.01 μV rms) into 50 ohm resistive load; output attenuator calibrated in 10 dB steps from 1.0V (+13 dBm) full scale to 0.03 μV (−137 dBm) full scale; vernier provides continuous adjustment between attenuator ranges; output level indicated on output level meter calibrated in volts and dBm into 50 ohms.

Accuracy: (Local and remote modes)
±1.5 dB +10 dBm to −76 dBm.
±2.0 dB −77 dBm to −146 dBm.

Flatness: Output level variation with frequency is less than ±1.0 dB across entire frequency range. (Typically ±0.5 dB 100 MHz to 1300 MHz.)

Level Switching Time: Any level change may be accomplished in less than 50 ms. Any change to another level on the same attenuator range may be accomplished in 5 ms in REMOTE mode.

Impedance: 50Ω. SWR <2.0 on 1 volt and 0.3 volt ranges. SWR <1.3 on 0.1 volt range and below.

Table 1-1. Models 86602A/11661 Specifications (2 of 2)

MODULATION CHARACTERISTICS (With 86632A and 86633A AM-FM Modulation Sections)

Amplitude Modulation:

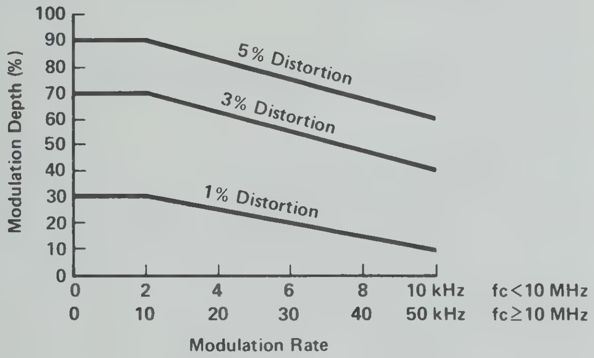
Depth: 0 — 90% on 0.3 volt range and below. (Modulation is possible on 1V range depending on setting of vernier.)

AM 3 dB Bandwidth:

Center Frequency	0 to 30% AM	70% AM	90% AM
Fc <10 MHz	10 kHz	6 kHz	5 kHz
Fc ≥10 MHz	100 kHz	60 kHz	50 kHz

AM Distortion: (at 400 Hz and 1 kHz rates)[1]

Frequency Range	30%	70%	90%
1–1300 MHz	<1%	<3%	<5%



(RF meter set at 0dB or above)

Typical 86602A AM distortion curves

Indicated AM Accuracy: (400 Hz and 1 kHz rates using internal meter) ±5% of full scale.

Incidental PM: Less than 0.2 radians peak at 30% AM.

Incidental FM: 0.2 x f_{mod} at 30% AM.

Frequency Modulation: [2]

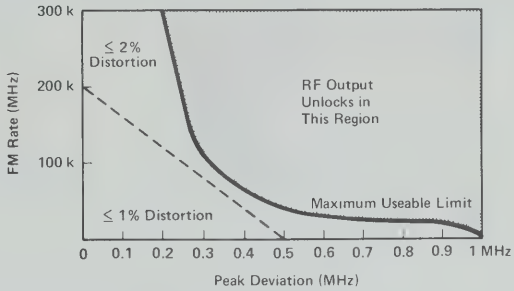
Rate: DC to 200 kHz with 86632A
DC to 100 kHz with 86633A

Max. Deviation: DC to 200 kHz with 86632A
DC to 100 kHz with 86633A

Indicated FM Accuracy: ±5% of full scale up to 20 kHz rates.

Incidental AM: With 75 kHz peak deviation at a 1 kHz rate, AM modulation sidebands are <−60 dB.

FM Distortion: (at rates up to 20 kHz) <1% for deviations up to 200 kHz.



Typical 86602A FM distortion curves

PULSE MODULATION (With the 86631B Auxiliary Section)

Source: External.

ON/OFF Ratio: At least 40 dB (with modulation level control at max.)

Rise/Fall Time: 50 ns.

Input Level Required: 0 to −10V negative voltage turns RF on.

REMOTE PROGRAMMING (Through the 8660-series mainframes)

Frequency: Programmable in 1 Hz steps over full output range.

Output Level: Programmable in 1 dB steps from +10 to −146 dBm.

Modulation: See specifications for modulation section installed.

GENERAL

Leakage: Meets radiated and conducted limits of MIL-I-6181D.

86602A:

Size: Plug-in to fit 8660-series mainframe.

Weight: Net, 9 lb (4,1 kg).

11661:

Size: Module installs internally in 8660-series mainframe.

Weight: Net, 4 lb (1, 8 kg)

---

[1] This is for RF output meter set at 0 dB or above. At −6 dB setting, distortion is approximately doubled.

[2] In the FM mode (86632A only), carrier frequency stability is determined by a free-running modulation oscillator. The oscillator can be phase-locked momentarily to remove drift by depressing the FM-CF CAL button. Oscillator drift is typically less than 200 Hz/hour after 6-hour mainframe warmup and 30 minutes operation in FM mode.

1-12. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to this manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-13. For information concerning a serial number prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-14. DESCRIPTION

1-15. The HP Model 86602A RF Section is one of several RF Sections available for use in an 8660-series Synthesized Signal Generator System. The HP Model 86602A RF Section plug-in is used with a Synthesized Signal Generator mainframe that has a Frequency Extension Module installed. The 86602A provides precisely tuned RF output frequencies over the 1 MHz to 1.3 GHz range with a 1 Hz frequency resolution (100 Hz for option 004 mainframe). Frequencies from 200 kHz to 1 MHz can also be generated with some degradation in the amplitude leveling and related specifications of the instrument.

1-16. The output power can be set to any level between +10 and −146 dBm by means of the front panel VERNIER and calibrated OUTPUT RANGE controls. A front panel-mounted meter indicates the output power and voltage levels delivered by the RF Section to any external load having a characteristic impedance of 50 ohms. Output power levels are maintained within ±1 dB of selected values through internal leveling of the output signal over the full frequency range of the instrument.

1-17. AM, FM, or pulse modulation of the RF OUTPUT signal can be accomplished within the 86602A by using the appropriate HP plug-in (Auxiliary Section or AM-FM Modulation Section) in the system.

1-18. External programming, inherent with the 86602A and associated HP equipment, permits remote selection of the output signal frequency in 1 Hz steps (100 Hz for option 004 mainframe) and the output power level in 1 dB steps over the full operating range of the instrument. External programming is effected via the mainframe computer-compatible interface and digital control unit circuits.

1-19. OPTION 001

1-20. Option 001 has no RF output attenuator. Output ranges selectable with OUTPUT RANGE switch are 0 and +10 dBm only.

1-21. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-22. System Mainframe

1-23. The mainframe uses phase-locked loops to accurately generate clock, reference, and tuning signals required for operation of the Synthesized Signal Generator System. Front panel-mounted mainframe controls are used to digitally tune two phase-locked loops in the Frequency Extension Module which, in turn, produce two high-frequency output signals that are applied to the RF Section. The RF Section mixes the two signals and presents their frequency difference at the front panel OUTPUT jack. The output frequency is either the value selected by the mainframe front panel controls or externally programmed.

1-24. The mainframe power supply provides all dc operating voltages required by the 86602A, Frequency Extension Module, and AM-FM Modulation Section plug-ins. Remote programming of the plug-ins is accomplished via the mainframe interface and digital control unit circuits.

1-25. Frequency Extension Module

1-26. The Frequency Extension Module plug-in extends the output frequency range of the mainframe to meet the input requirements of the 86602A. The Frequency Extension Module plug-in contains two high-frequency phase-locked loops which receive digital tuning signals, variable synthesized signals, and fixed synthesized signals from the mainframe. The phase-locked loops use the mainframe signals, in conjunction with the output frequency from a 4.43 GHz oscillator that is common to both loops, to produce two high-frequency output signals that are supplied to the 86602A. One output signal is generated by a phase-locked loop using a Voltage Controlled Oscillator (VCO) that is tuneable in 1 Hz steps (100 Hz steps for option 004 mainframe) over the

Table 1-2. Test Equipment and Accessories List (1 of 2)

Item	Critical Specifications	Suggested Model	Use*
Digital Voltmeter	Accuracy: ±0.2% Range: .00 to 60 Volts	HP 34740A with HP 34702A	T
AC Voltmeter	1 Hz to 1 MHz 1 mVrms to 10 Vrms	HP 403A	P,A
Vector Voltmeter	10 to 100 MHz 0.1 to 1.0 Vrms	HP 8405A	P
Accessory Kit (Vector Voltmeter)	50Ω Load and Tee	HP 11570A	P
Oscilloscope	Vertical: Bandwidth 50 MHz with sensitivity of 5 mV/division minimum Horizontal: Sweep time 10 ns to 1 s Delayed sweep External triggering to 100 MHz	HP 180A with HP 1801A and HP 1821A plug-ins	P,T
10 ÷ 1 divider probes (two)	10:1 divider 10 Megohm 10 pF	HP 10004	
Spectrum Analyzer	Absolute Accuracy ±1.6 dB from 10 MHz to 1.3 GHz Measurement Accuracy ±2.6 dB from 10 MHz to 1.3 GHz	HP 8555A with HP 8552B and HP 140S	P,A,T
Test Oscillator	1 kHz to 20 kHz 0.2 to 2.0 Vrms into 50Ω	HP 651B	P,A
Synthesized Signal	±1 Hz from .01 MHz to 110 MHz ±2 dB from +10 to −90 dBm	HP 8660A with HP 86631B and HP 86602A plug-ins	P
Modulator Section	1 kHz FM with 1 MHz peak deviation	HP 86632A	P
Computing Counter	50 kHz to 50 MHz with a 1 ms gate time and external trigger; 1 Hz resolution	HP 5360A with HP 5365A plug-in	P
Wave Analyzer	20 Hz to 40 kHz	HP 302A	P
Crystal Detector	100 kHz to 100 MHz	HP 8471A	P
Power Supply	0 - 10 volts	HP 721	P
Marked Card Programmer	Capable of programming BCD or GPI bus data	HP 3260A Opt 001	P,A

*USE: P = Performance Tests; A = Adjustments; T = Troubleshooting

Table 1-2. *Test Equipment and Accessories List (2 of 2)*

Item	Critical Specifications	Suggested Model	Use*
Frequency Meter/ FM Discriminator	100 kHz to 10 MHz with 1 volt output sensitivity	HP 5210A	P
Variable Coaxial Attenuator	Calibrated at 30 MHz; refer to calibration curve	HP H38-355D (only)	P
Double Balanced Mixer	1 MHz to 110 MHz	HP 10514A	P
BNC Tee		UG 274 B/U	P,A
Variable Phase Generator	Distortion less than 3% Range: 1 kHz to 20 kHz Output level: 0.1 to 1.0 Vrms	HP 203A	P
15 kHz Lowpass Filters (two)	Special	(see Figure 1-3)	P
100 kHz Lowpass Filter	Special	(see Figure 1-4)	P
40 dB Amplifier	Special	(see Figure 1-5)	P
Service Kit	Interconnect cables, adaptors, coaxial cables compatible to 8660-series plugs and jacks	HP 11672A (see Operating Note for parts list)	A, T
Microwave Frequency Counter	Range: 0.2 - 1300 MHz Resolution: 1 Hz	HP 5340A	P
Power Meter	Range: 0 to +10 dBm from 10 MHz	HP 432A	P,A,T
Thermistor Mount	1 MHz - 1 GHz at SWR ⩽ 1.3	HP H55-478A	P,A
Fixed Attenuator	3 dB	HP 8491A Opt. 003	P,A
Pulse Generator	Output —10 Vpk with ⩾10 ns risetime	HP 8013A	P
Crystal Detector	Frequency response to 10 GHz	HP 420A	P
Low Pass Filter	Cutoff frequency: 2200 MHz	HP 360C	P
Termination, 50Ω Feedthru	50Ω	HP 11048C	P
Double Balanced Mixer	100 to 1300 MHz	Relcom MIA-11	P

*USE: P = Performance Tests; A = Adjustments; T = Troubleshooting

3.95 to 4.05 GHz range. The other output signal is generated by a phase-locked loop using a Yittrium-Iron-Garnet (YIG) oscillator that is tunable in 100 MHz steps over the 2.75 to 3.95 GHz range. The two outputs from the Frequency Extension Module plug-in are applied to the 86602A for mixing, amplification of the converted signal, and final output power level control.

1-27. Auxiliary Section

1-28. The Auxiliary Section plug-in provides a means of applying externally generated amplitude or pulse modulation drive signals to the 86602A for modulation of the generated output carrier.

1-29. Modulation Section Plug-ins

1-30. The Model 86630-series AM-FM Modulation Section plug-ins can accept externally generated signals or develop internal signals to be used for calibrated amplitude or frequency modulation of the output signal from the 86602A. The AM signals are supplied to the 86602A for modulation of the generated output carrier as previously described in the paragraph discussing the Auxiliary Section plug-in.

1-31. In the FM mode, the AM-FM Modulation Section plug-in supplies a 20 MHz frequency modulated signal to the reference input of a phase detector in the Frequency Extension Module phase-locked YIG loop. Thus, as the 20 MHz frequency modulated signal varies, the YIG loop output frequency varies accordingly. When the modulated YIG loop output is mixed in the 86602A with the VCO loop output, the resultant RF signal retains the FM characteristics provided by the AM-FM Modulation Section plug-in.

1-32. EQUIPMENT AVAILABLE

1-33. Three extender cables, HP Part Numbers 11672-60001, -60005, and -60006, are required to extend the 86602A plug-in for maintenance purposes. The extender cables are part of the HP 11672A Service Kit, but may be ordered separately.

1-34. Extender cards for use in servicing the 86602A and a type N to BNC adapter for use on the front panel RF OUTPUT connector are contained in the HP Rack Mount Kit, Part Number 08660-60070, that is supplied with the mainframe.

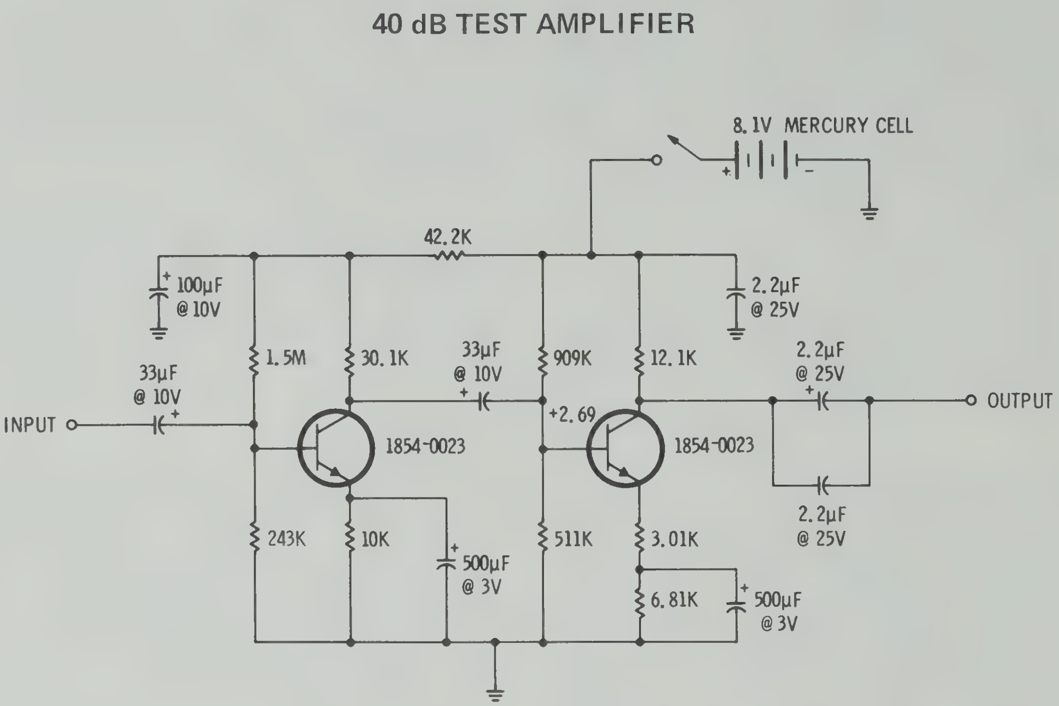
1-35. RECOMMENDED TEST EQUIPMENT

1-36. Table 1-2 lists the test equipment and accessories recommended for use in testing, adjusting, and servicing the 86602A. If any of the recommended test equipment is unavailable, instruments with equivalent specifications may be used.

1-37. SAFETY CONSIDERATIONS

1-38. This instrument has been designed in accordance with international safety standards and has been supplied in safe condition.

1-39. Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to retain the instrument in safe condition. Be sure to read and follow the safety information in Sections II, III, V, and VIII.



Amplifier Specifications

Gain	44 dB at 25°C
Bandwidth	100 kHz (3 dB down)
Noise Bandwidth	157 kHz
Input Impedance	75 K Ohms
Output Impedance	12 K Ohms
Current Drain	260 Microamperes
Output (Maximum)	1 Volt
Dynamic Range	66 dB

Figure 1-2. 40 dB Test Amplifier

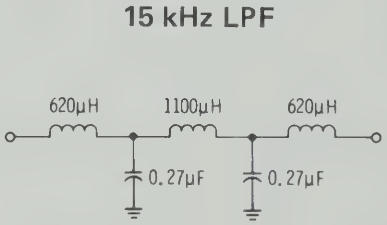


Figure 1-3. 15 kHz Low Pass Filter

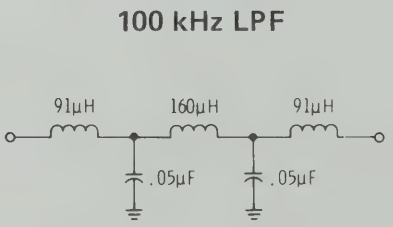


Figure 1-4. 100 kHz Low Pass Filter

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section provides information relative to initial inspection, preparation for use, and storage and shipment of the Model 86602A RF Section plug-in. INITIAL INSPECTION provides instructions to be followed when an instrument is received in a damaged condition. PREPARATION FOR USE gives all necessary interconnection and installation instruction. STORAGE AND SHIPMENT provides instructions and environmental limitations pertaining to instrument storage; also provided are packing and packaging instructions which should be followed in preparing the instrument for shipment.

2-3. INITIAL INSPECTION

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1, and procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. All power required for operation of the 86602A is furnished by the mainframe. The 86602A requires approximately 70 volt-amperes.

2-8. Interconnections

2-9. Prior to installing the 86602A plug-in into the mainframe, verify that the Frequency Extension Module plug-in and interconnecting cable assemblies have been installed in accordance with the instructions contained in the Frequency Extension Module manual.

2-10. Operating Environment

2-11. The Model 86602A RF Section is designed to operate within the following environmental conditions:

Temperature	0° to +55°C
Humidity	less than 95%, relative
Altitude	less than 15,000 feet

2-12. Installation Instructions

WARNING

The multi-pin plug connector which provides interconnection from mainframe to RF Section, will be exposed with the RF Section removed from the right-hand mainframe cavity. With the Line (Mains) Voltage off and power cord disconnected, power supply voltages may still remain which, if contacted, may result in personal injury.

2-13. Insert the 86602A plug-in approximately half-way into the right cavity of the mainframe. Rotate the latch (lower right corner of 86602A front panel) to the left until it protrudes perpendicular to the front panel. Refer to Figure 2-1, which shows the 86602A plug-in partially inserted into the mainframe and the latch rotated to a position that is perpendicular to the plug-in front panel. Push the 86602A plug-in all the way into the mainframe drawer and then rotate the latch to the right until it snaps into position.

2-14. STORAGE AND SHIPMENT

2-15. Environment

2-16. The storage and shipping environment of the Model 86602A should not exceed the following limits:

Temperature . . . 40° to +75°C
Humidity . less than 95%, relative
Altitude . . . less than 25,000 feet

2-17. Packaging

2-18. Original Type Packaging. Containers and materials identical to those used in factory packaging are available thorugh Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-19. Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.)

b. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

c. Use enough shock-absorbing material (3- to 4-inch layer) around all the sides of the instrument to provide firm cushion and prevent movement inside the container. Protect the control panel with cardboard.

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

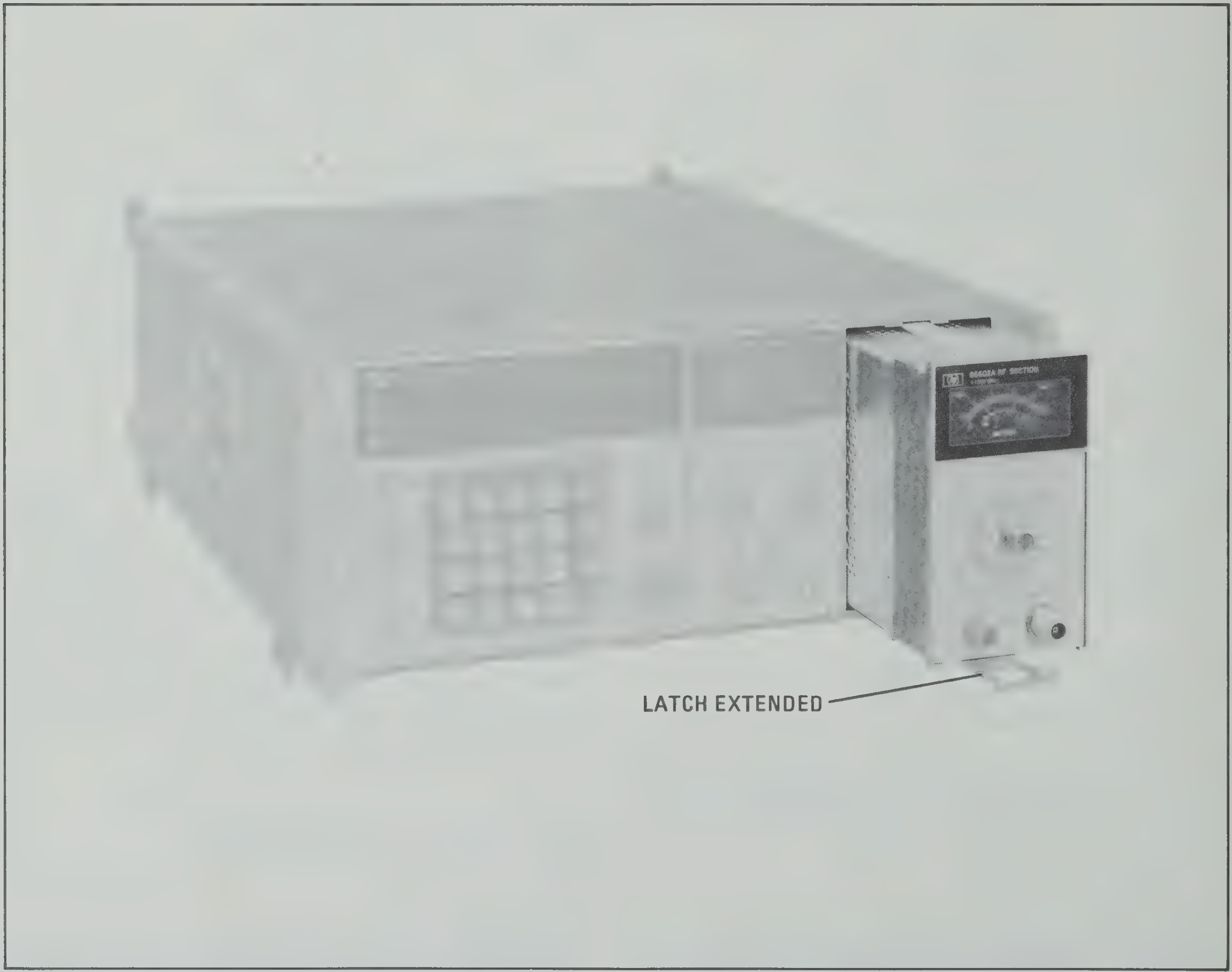


Figure 2-1. RF Section Partially Inserted into Mainframe

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section contains information which will enable the operator to learn to operate and quickly check the proper operation of the RF Section plug-in as part of the Synthesized Signal Generator System.

3-3. PANEL FEATURES

3-4. The Front and Rear Panel Controls, Connectors, and Indicators of the RF Section are described by Figure 3-1.

3-5. OPERATOR'S CHECKS

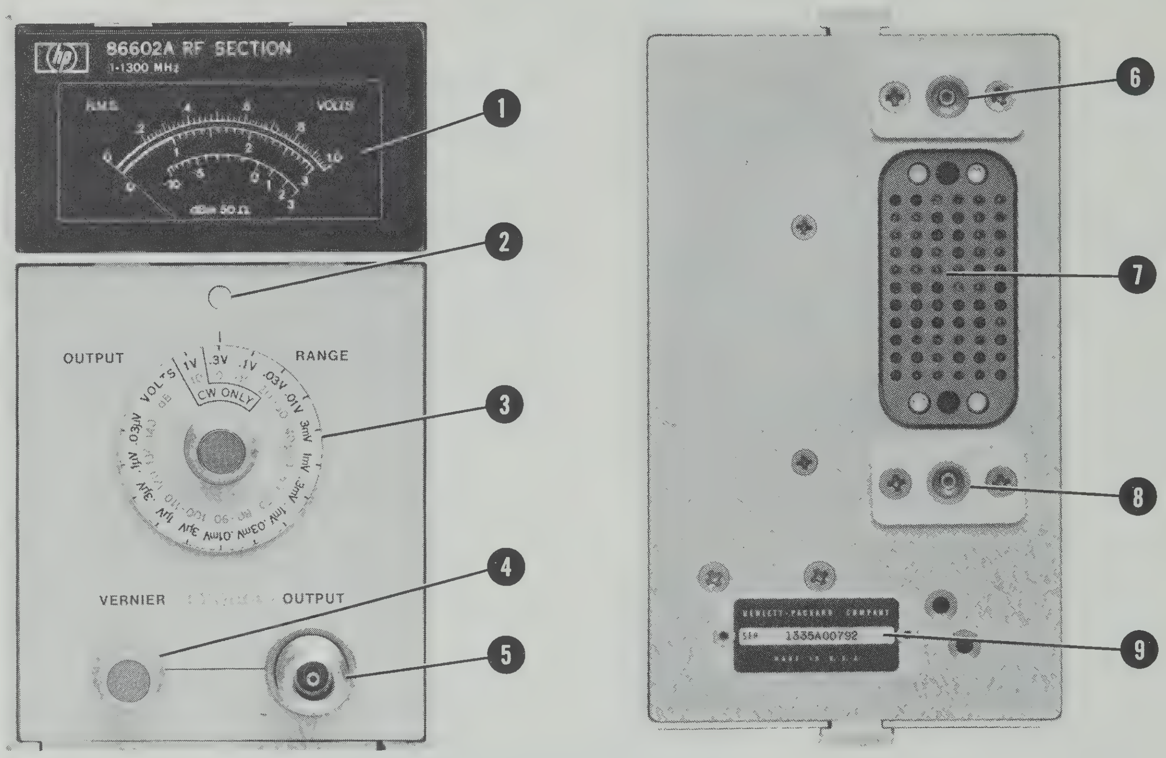
3-6. The RF Section, as part of the Synthesized Signal Generator System, accepts inputs from the rest of the system but controls only the RF Output level. Even though the controlled circuits for these functions are within the RF Section, the actual checks are found in the manual of the instrument which controls that function.

3-7. The Operator's Checks in this manual are intended to verify proper operation of the circuits which control and are controlled by the RF Output level controls. This includes the meter, VERNIER control, OUTPUT RANGE Switch, and the Output Range Attenuator when operating in the Local mode. When the system is being remotely controlled, the 1 dB and 10 dB remote step attenuators switches are checked in place of the VERNIER Control and OUTPUT RANGE Switch. Refer to Figure 3-2.

3-8. OPERATING INSTRUCTIONS

3-9. In this system, the mainframe and plug-ins contain the controls for frequency, modulation, and RF level selection. The mainframe controls frequency, the Modulation Section plug-in controls modulation type and level, and the RF Section plug-in controls RF output level. The Operating Instructions for the RF Section plug-in are included in Table 3-1.

FRONT AND REAR PANEL FEATURES



❶ **Meter.** Indicates the RF Output level in Vrms and dBm (50Ω) referenced to the scale indicated by the OUTPUT RANGE Switch.

❷ **Mechanical Meter Zero Control.** Sets the Panel Meter indicator to zero when the Mainframe LINE Switch is set to STBY.

❸ **OUTPUT RANGE Switch.** Sets the RF Output level range from +10 to −140 dBm in 10 dB steps (1.0 Vrms to 0.03 μVrms full scale).

❹ **VERNIER Control.** RF Output continuously variable within the useable 10 dB range (+3 to −6 dB) as indicated by the meter.

❺ **OUTPUT Jack.** Type-N female coaxial connector. RF Output level +10 to −146 dBm (1.0 Vrms to 0.01 μVrms) across a 50Ω load.

❻ **Coaxial Plug.** Connects the 2.75/3.95 GHz RF Input signal to the RF Section from the Frequency Extension Module.

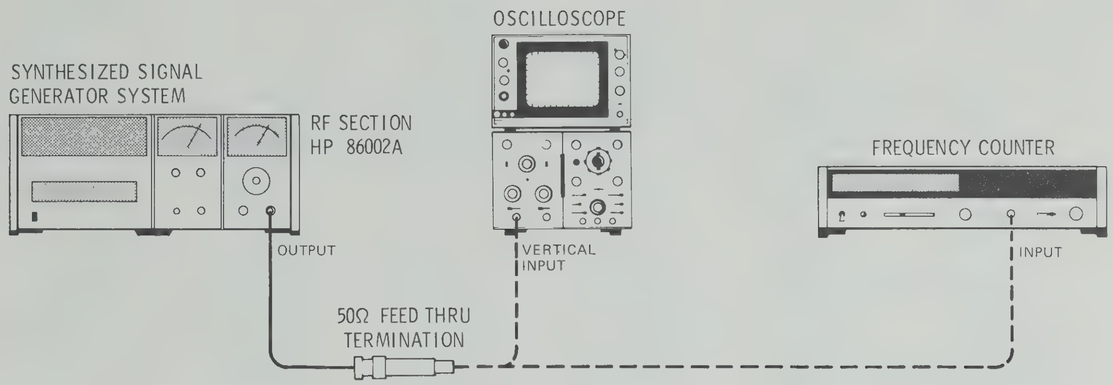
❼ **Interconnect Plug.** Provides interconnection of power supply voltages, RF and control signals between the RF Section plug-in and the Mainframe, Frequency Extension Module, and Modulation Section plug-in.

❽ **Coaxial Plug.** Connects the 3.95/4.05 GHz LO Input signal to the RF Section plug-in from the Frequency Extension Module.

❾ **Serial Number Plate.** Metal plate with stamped serial number. Four-digit and letter for prefix. Suffix is unique to this instrument.

Figure 3-1. Front and Rear Panel Controls, Connectors, and Indicators

OPERATOR'S CHECKS



WARNING

BEFORE CONNECTING THIS SYSTEM TO LINE (MAINS) VOLTAGE, the safety and installation instructions found in Sections II and III of the mainframe manual should be followed.

NOTE

Refer to Section II for RF Section Installation instructions.

1. Set the system controls as follows:

Mainframe	
LINE Switch	ON
REFERENCE SELECTOR (Using internal time base)	INT
CENTER FREQUENCY	10 MHz
Modulation Section Plug-in	
MODE Switch	OFF
RF Section Plug-in	
OUTPUT RANGE Switch	−10 dBm (0.1V)
VERNIER Control (for a meter reading of +3 dB)	−7 dBm (0.1 Vrms)

2. Connect the system's OUTPUT to the oscilloscope's vertical input (>10 MHz bandwidth) and then to the frequency counter's input through a 50Ω feed-thru termination. Verify that the amplitude of the 10 MHz signal is ≈280 mVp-p.

3. Set the OUTPUT RANGE Switch to the +10 dBm (1.0V) range. Verify that the output level is ≈2 Vp-p.

4. To check the remote control capabilities of the RF Section, connect a control unit to the mainframe. Repeat steps 2 through 4 while the system is remotely programmed from an external source. Application Note 164-1 "Programming the 8660A/B Synthesized Signal Generator" provides the information needed for remote operation of this system. Section III of the mainframe manual contains the same information in abridged form.

Figure 3-2. Operator's Checks

Table 3-1. Operating Instructions

OPERATING INSTRUCTIONS

TURN ON

WARNING

BEFORE CONNECTING THIS SYSTEM TO THE LINE (MAINS) VOLTAGE, the safety and installation instructions found in Sections II and III of the mainframe manual should be followed.

NOTE

Refer to Section II for RF Section Installation Instructions.

1. Set the mainframe's LINE Switch to ON and the rear panel REFERENCE SELECTOR Switch to INT.

FREQUENCY SELECTION

2. Refer to Section III of the mainframe operation and service manual for information on system frequency selection.

MODULATION SELECTION

3. Refer to Section III of the Modulation Section plug-in operating and service manual for information relating to selection of modulation type and level.

RF OUTPUT LEVEL

4. Set the OUTPUT RANGE Switch and the VERNIER Control for the desired output level. To ensure the accuracy of the output level and/or modulated output, the meter reading of output level should always be set between —6 and +3 dBm.

REMOTE OPERATION

5. Application Note 164-1 "Programming the 8660A/B Synthesized Signal Generator" provides the information needed for remote operation of this system. In abridged form, Section III of the mainframe manual contains the same information.

GENERAL

6. Connect the RF Output to the Device Under Test. The front panel meter reading of RF Output level will be correct only if the input impedance of the Device Under Test is 50Ω.

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